
I. USING SYNCLAVIER® II

This section introduces you to Synclavier® II. First, you will learn about the components of the Synclavier® II real-time performance system. Then, through step-by-step instructions, you will learn to perform on the keyboard, record on the memory recorder, and use the pedal for real-time effects.

Once you have completed this section, you can turn to the rest of the manual for details.

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WHAT IS A SYNCLAVIER® II — AN INTRODUCTION

The compact Synclavier® II **real-time** performance system consists of a keyboard unit, the Digital Synthesizer (which contains a computer *and* the digital synthesizers), one or two disk drives, various connecting cables, and the software that is stored on floppy diskettes.

THE KEYBOARD UNIT

The keyboard unit is designed for ease and speed of operation.

The control panel above the keyboard is used to control precisely the "timbre" of the notes triggered by the keys as well as to operate the 16-track digital memory recorder. The control knob and digital display window are located on the left of the panel. The rest of the panel consists of four groups of buttons, all logically organized and clearly labeled according to their musical functions. The memory recorder buttons are located in the center for heavy use during performance, the timbre control buttons are located on either side, and the buttons for transfer of information to and from the diskette are located on the far right.

Control Knob and Digital Display Window

In contrast to analog synthesizers, which have a separate knob for every function, Synclavier® II requires only one control knob for all of its functions. You use it to make changes in timbres, to adjust the keyboard range, to establish non-Western scales. During operation of the memory recorder, you use the knob to separately adjust playback speed or tuning. You can even use the control knob for performing pitch bend.

The digital display window provides an instantaneous visual readout of all changes that you make with the knob. When you begin operation, the window displays the number of voices in your system. When you recall a timbre from the diskette, the window displays the number of voices used by the timbre. During recording, it displays the beat of the digital metronome and the number of notes you have left in the memory recorder. From time to time, the window will also display various error messages.

No matter what function you are changing, the control knob always works in the same way. It is a spring-loaded knob and can be turned from about an 11 o'clock position to the left to 1 o'clock to the right. When you turn the control knob to the left, you decrease the numbers in the window. When you turn the knob to the right, you increase the numbers. The farther you turn the knob to the left or to the right, the faster the numbers change.

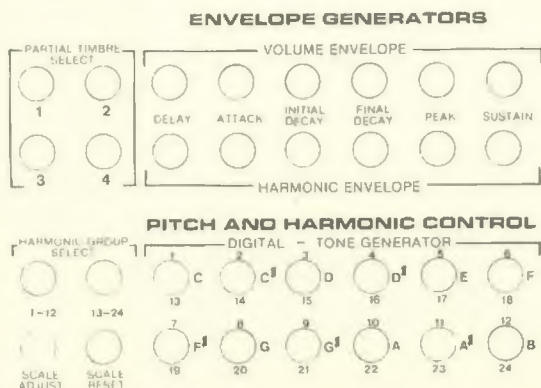
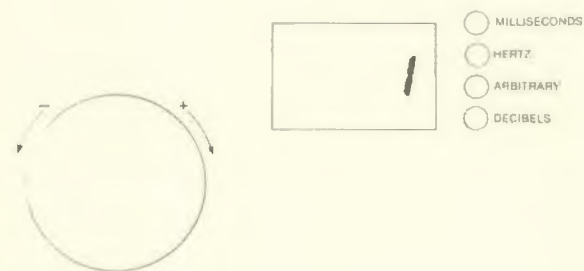
Whenever you release the knob, the number currently displayed in the window will be memorized by the computer, and will remain in effect until you change the setting or turn off the system.

The Buttons

From left to right, the buttons are divided into four panels:

1. ENVELOPE GENERATORS and PITCH AND HARMONIC CONTROL

These buttons are used along with the control knob to program the foundation of each timbre. You use them to adjust the harmonic content of the timbre and its volume during the attack, sustain, and decay portions of the note. Both volume envelope (VE) parameters and harmonic envelope (HE) parameters are included so that both loudness and harmonic content can be programmed to vary during a note.

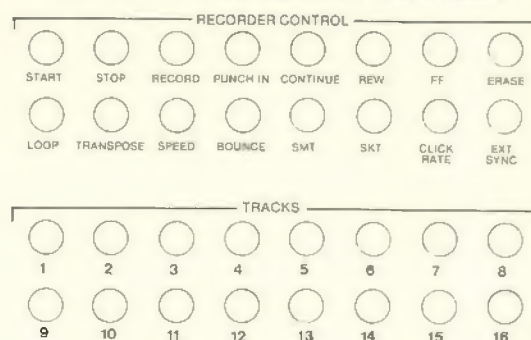


2. 16-TRACK DIGITAL MEMORY RECORDER

You use the buttons in this panel to operate the Synclavier® II polyphonic memory recorder. You can record and play back a sequence of up to 10,000 notes with up to 16 different timbres and can modify the sequence in many ways.

This one panel of buttons gives you creative control which far surpasses the ordinary keyboard synthesizer.

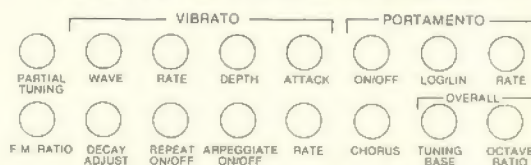
16 TRACK DIGITAL MEMORY RECORDER



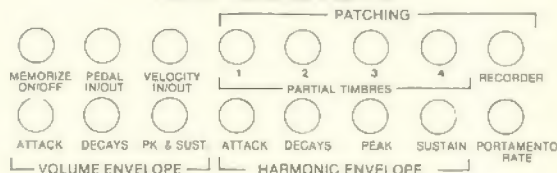
3. KEYBOARD INSTRUMENT CONTROL and REAL TIME EFFECTS

You use the buttons in the third panel to enrich and musically modify the timbres and to create special keyboard and real-time effects.

KEYBOARD INSTRUMENT CONTROL



REAL TIME EFFECTS

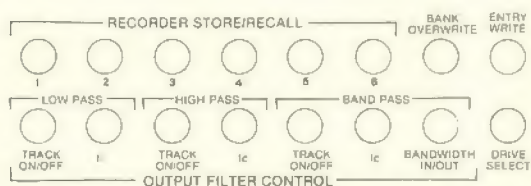
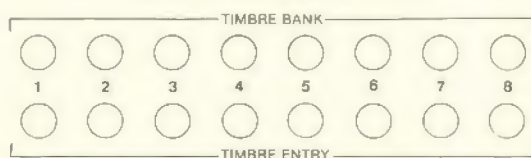


4. TIMBRE STORE/RECALL and RECORDER STORE/RECALL

When you want to recall a preset timbre from a diskette or store a new timbre, you use the buttons in the upper fourth panel. To store or recall an entire recorded sequence of notes along with their associated timbres, turn to the buttons on the lower fourth panel. Storing or recalling timbres or sequences takes place almost instantaneously.

Also located in this panel are several buttons that allow you to control external voltage-controlled filters or any other voltage-controlled equipment.

TIMBRE STORE/RECALL



Knob Buttons and Function Buttons

The buttons can be divided into two general categories: those that change the digital display—**knob buttons**—and those that do not—**function buttons**.

Knob buttons are used to designate a particular function for the control knob. When you press a knob button, such as volume ATTACK or recorder SPEED, a setting will appear in the digital display window. You then use the control knob to dial a change in that setting.

Function buttons do not affect the control knob or the digital display. They are used for a variety of purposes, such as choosing a timbre for the keyboard, selecting a track for recording, or turning the portamento function on or off.

THE SYNCLAVIER® II DIGITAL SYNTHESIZER

The Synclavier® II Digital Synthesizer contains the computer that controls the system and the digital synthesizers that produce the actual sounds.

The Computer

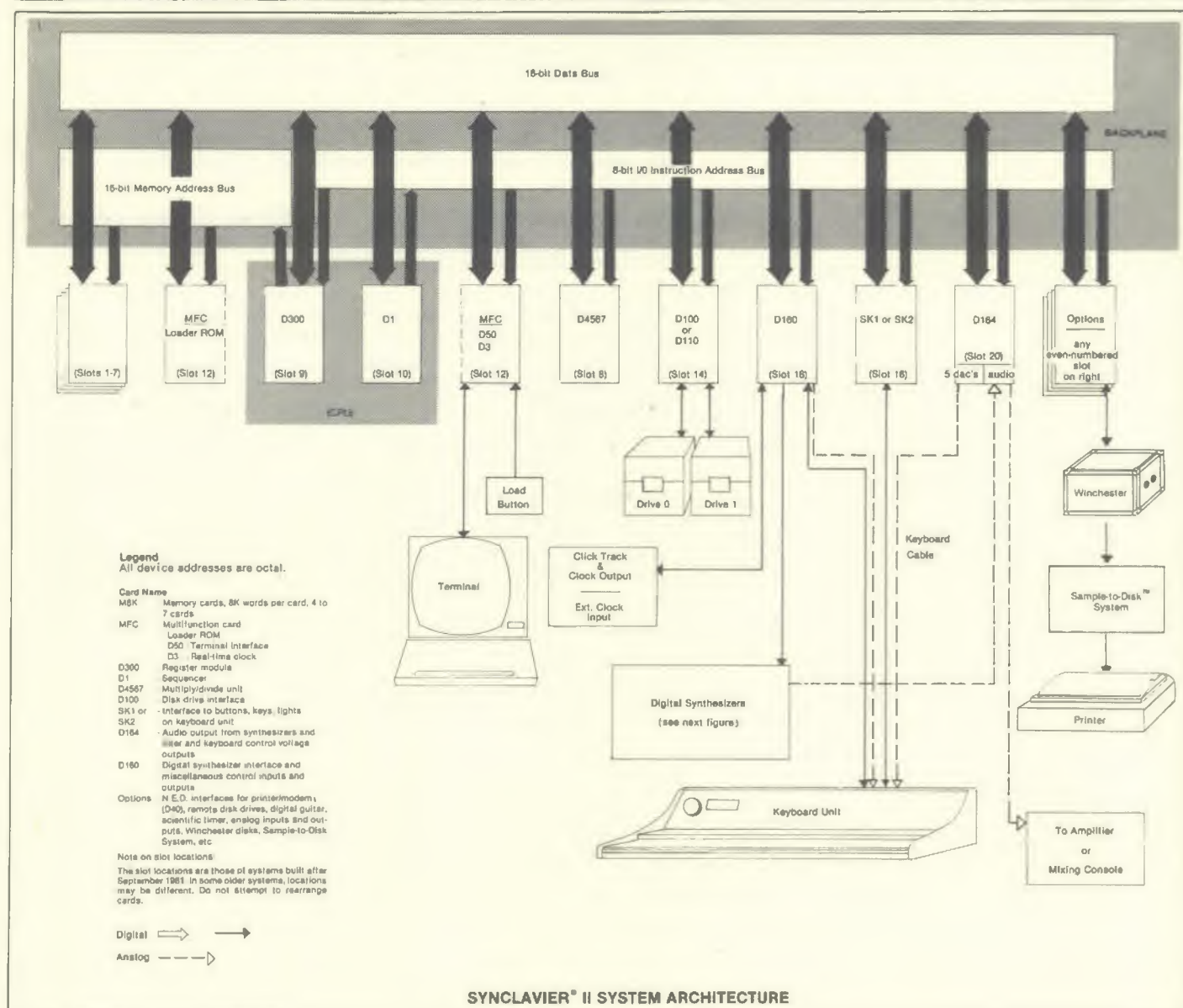
A computer used for music synthesis must carry out a tremendous variety of jobs instantly and simultaneously. New England Digital's 16-bit Able computer more than fulfills the requirements for professional synthesis and performance.

The power of the Able computer is based on its architecture, which allows high-speed access to between 32,000 and 56,000 16-bit words of memory, depending on the number of memory boards in your system. The highly efficient architecture also permits the control of a complete and complex real-time operating system, such as the Synclavier® II digital synthesis system, by a *single* central processor. This efficiency greatly simplifies the programming of the system.

The language used to program the system, Scientific XPL, is a high-level, structured language. New software modules can be, and frequently are, added to the system software without the need to reprogram the original operating system.

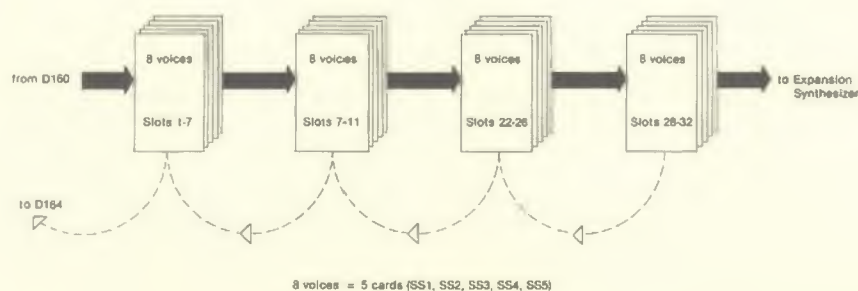
The Able computer is one of very few computers in the world specifically designed to operate with compiler-generated software. This designed-in compatibility is a major reason for the combination of power and affordability in the Synclavier® II system.

The large amount of memory in the Synclavier® II computer allows you to perform and record multitrack, polyphonic musical sequences. If your computer has 56,000 words of memory, you can record compositions with up to 10,000 notes. Low-cost expansion memory boards can be plugged in at any time.



DIGITAL SYNTHESIZERS

32-Voice System



Digital \Rightarrow
Analog \dashrightarrow

Note: In all systems built after September 1981, the computer and the synthesizers are housed in separate bins. In some older systems, both computer and synthesizers are housed in the same bin.

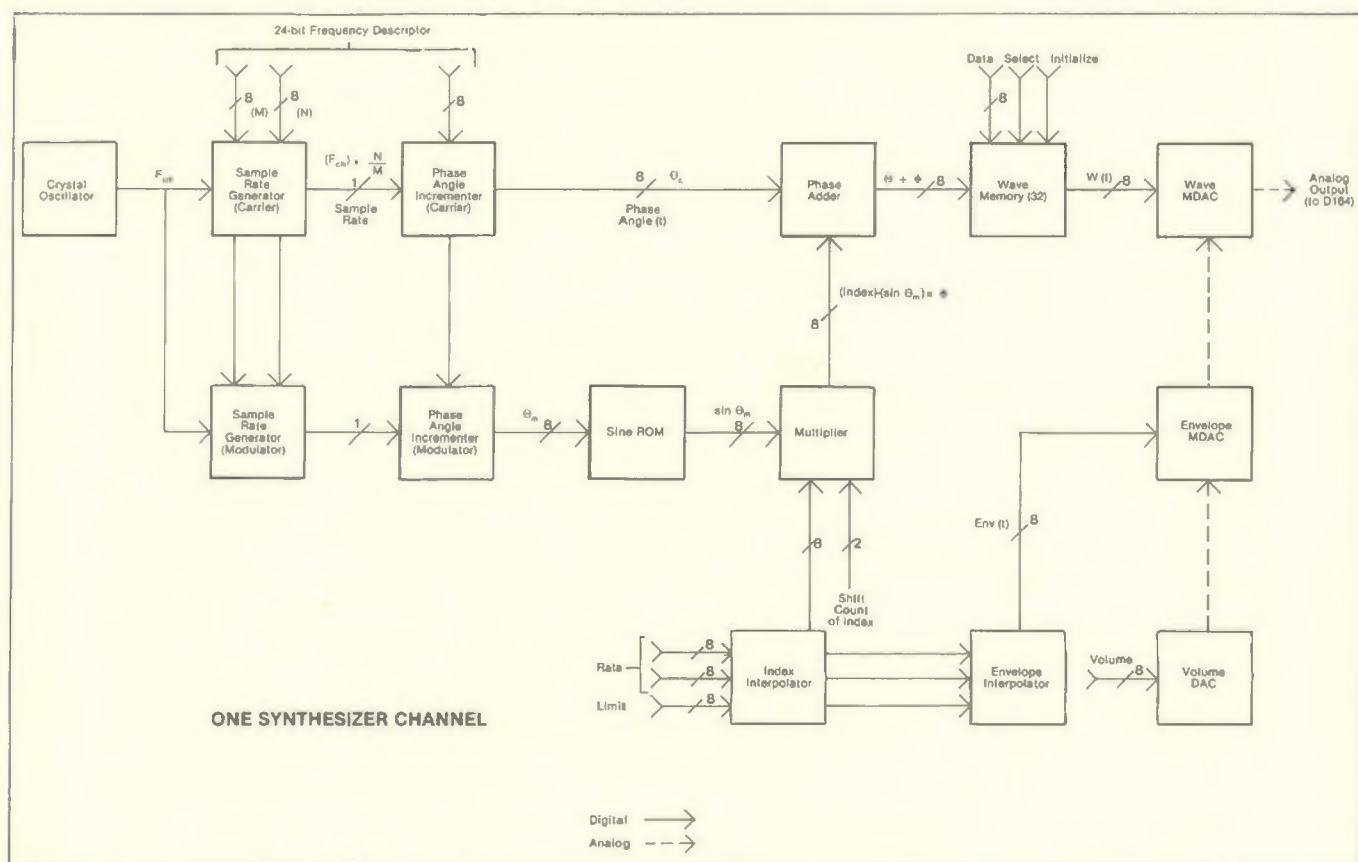
The Digital Synthesizers

The efficiency of Synclavier® II digital synthesis is based on patented technology. High frequency resolution provides for glitch-free portamento and vibrato and prevents alias distortion. Both additive and FM synthesis can be performed by the synthesizers.

The digital synthesizers produce waveforms by generating a series of numbers which are converted by the digital-to-analog converters into actual audio waveforms.

For professional quality sound, the numbers must be generated at extremely high rates (32 kHz minimum). If every number were individually computed, the necessary rate of computation would exceed the capability of even a powerful computer. In the Synclavier® II system, the computer determines the properties of the note (its harmonic content, volume envelope, duration, pitch, etc.) and transfers this information to the synthesizers in the form of a compact set of *parameters*. The digital synthesizers then carry out the repetitive tasks of synthesizing the digital waveforms.

Each synthesizer is built on five boards and contains eight synthesizer channels or voices. More voices can be added to the system at any time by installing more synthesizer boards.



The Disk Drives

The disk drives provide a means of communicating the operating instructions, as well as timbres and sequences, that are stored on diskette to the computer.

Your system will have one or two disk drives. If you have one drive, you will use it for loading the operating system and for recalling and storing timbres and sequences. If you have two drives, one will be the MAIN or *left-hand* drive and one will be the AUXILIARY or *right-hand* drive. You will use the MAIN drive for loading the operating system. You will use both drives for recalling and storing timbres and sequences.

A second disk drive can be added at any time to the standard system.

SOFTWARE

As with all computer systems, the key element for successful operation is the software. The software for Synclavier® II can be divided into two types: system and user.

The system software consists of the computer program, or operating system, which runs Synclavier® II. The operating system coordinates all input from the keys, buttons and knob on the keyboard unit and all output to the digital synthesizers.

The user software consists of the timbres and sequences that you may create and store on the diskettes. To get you started, New England Digital supplies you with many preprogrammed timbres which can be recalled, played and modified.

All software is stored on floppy diskettes, either 5 1/4 inch (minidiskettes) or 8 inch (maxidiskettes). The system software is stored on the system diskettes. The user software is stored on both system and timbre diskettes.

System Diskettes

The personality of Synclavier® II is completely dependent on the system software. When you insert the system diskette into the left-hand drive and press the LOAD button, you determine the exact nature of Synclavier® II operation. For example, if you load from the SCRIPT system diskette rather than from the Synclavier® II system diskette, Synclavier® II can be controlled from a computer terminal. Or, by loading from a new release of the Synclavier® II system diskette, you can add new features or completely new capabilities to your Synclavier® II at any time. Your Synclavier® II will never become obsolete.

Besides containing a copy of the Synclavier® II operating system, the system diskette also contains some user software: 64 preprogrammed timbres plus two 1000-note sequences on the minidiskette version or five 10,000-note sequences on the maxidiskette version. (Many of these timbres and two sequences are used to illustrate various points in this manual.)

The amount of memory listed on the system diskette label must match the amount of memory installed in your computer. (If you have a computer terminal, you may "reconfigure" your system diskette to correspond to different amounts of memory, if, for example, you add memory to your system in the future. For instructions on this procedure, see the Options Setup Manual.)

Timbre Diskettes

The timbre diskettes contain only user software. Each timbre diskette contains 64 preprogrammed timbres, plus varying amounts of space for storing recorded sequences. The number and size of the sequences that can be stored are clearly labeled on each diskette.

These diskettes can be used to create your own permanent library of timbres and musical sequences that can be rapidly accessed at any time and repeatedly used with no loss of quality.

Diskettes Supplied with Minidiskette Systems

You should have two each of the following 5 1/4 inch diskettes, ten diskettes in all.

System Diskette — latest release of Synclavier® II Operating System and 64 timbres — two 1000 note sequences

Timbre Diskette #1 — 64 timbres — six 1000 note sequences

Timbre Diskette #2 — 64 timbres — one 10,000 note sequence — CONFIGUR program

Timbre Diskette #3 — 64 timbres — one 10,000 note sequence

Timbre Diskette #4 — 64 timbres — two 6400 note sequences

Diskettes Supplied with Maxidiskette Systems

You should have two each of the following 8 inch diskettes, ten diskettes in all.

System Diskette — latest release of Synclavier® II Operating System and 64 timbres — five 10,000 note sequences

Timbre Diskette #1 — 64 timbres — six 10,000 note sequences

Timbre Diskette #2 — 64 timbres — five 10,000 note sequences — CONFIGUR program

Timbre Diskette #3 — 64 timbres — six 10,000 note sequences

Timbre Diskette #4 — 64 timbres — six 10,000 note sequences

The timbres and prerecorded sequences on the system diskettes, both maxi and mini, are designed for use with this manual. The use of the CONFIGUR program on Timbre Diskette #2 is described in the Options Setup Manual.

Optional software is listed and described elsewhere.

The following instructions assume that your Synclavier® II system has been assembled and is operating properly, as described in the Setup Manual. If the OUTPUT EQUALIZATION switches are installed on your computer, they should be in the -IN- position to produce the right sound for the preset timbres and memory recorder sequences on your diskettes.

NOTE: Always insert the diskettes after turning on the power.

1. If you have a minidiskette system, turn on the disk drive.
2. Turn on the computer by pressing the power button.

At this point, random buttons may light up on the keyboard and strange sounds may emerge from the synthesizers.

3. Take a Synclavier® II system diskette and grasp it with the label up and the oval slot away from you.

(Only Release F, or later, system diskettes contain the timbres and demonstration sequences designed for use with this manual.)

4. Insert the diskette smoothly into the drive and lock.

If you have two disk drives, use the left-hand or MAIN drive.

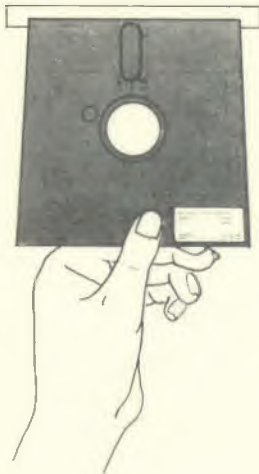
5. Press the LOAD button once and let go. The Synclavier® II operating system will now be automatically loaded into computer memory. While this is happening, you'll hear the drive motor run for about ten seconds in a minisystem and about three or four seconds in a maxisystem.

When the Synclavier® II operating system has been successfully loaded, the following things will occur:

- a. The number of voices installed in your system will appear in the digital display window.
- b. The TIMBRE BANK 1, TIMBRE ENTRY 1, PARTIAL TIMBRE SELECT 1, and HARMONIC GROUP SELECT 1-12 buttons will be lit (possibly along with a few others).
- c. The synthesizers will be silent.
- d. When you press a key on the keyboard, you'll hear a sine wave.

If your system does not behave in this manner, please check to see that you have inserted a *system* diskette, not a *timbre* diskette. If the drive motor keeps running continuously, however, it probably means that the diskette is defective. Try another system diskette.

6. Whenever you are ready to stop Synclavier® II operation, remove the system diskette from the drive *before* turning the power off. Electrical transients which occur when the power is turned on or off may generate stray magnetic fields that can corrupt the information stored on your diskette.



CARE AND HANDLING OF DISKETTES

The diskettes provided by New England Digital Corporation are of the highest quality available. To achieve the maximum in data reliability, you must handle the diskettes *carefully* and store them in a dust-free environment away from magnetic fields.

1. Always store your diskettes inside the protective jackets provided. Dust on the recording surface can ruin the diskette.
2. Always keep diskettes at a temperature between 50° F and 125° F. For best results, keep them at room temperature.
3. Never expose diskettes to stray magnetic fields. Avoid such common devices as telephones, microphones, dictation machines, as well as other instruments which contain small internal magnets.
4. Never *bend* or otherwise physically abuse a diskette.
5. Hold a diskette gently by the edges to avoid damaging the recording surface.
6. Never touch the exposed magnetic surface visible in the slot.
7. When inserting a diskette into the drive, hold it with the label up and the slot away from you. Be careful to insert it straight into the slot and never at an angle. The diskette should slide effortlessly into the drive. Any other condition indicates improper insertion.
8. Always remove diskettes from the disk drive before you turn the power to the computer on or off.
9. You may identify your diskettes by writing on the label. But always use a *felt tip pen*. Writing with a ball-point pen may damage the recording surface.

If you follow the above rules, your diskettes will be highly reliable. Any diskette that does become physically damaged by dirt, liquid, or rough handling should be replaced immediately, to avoid harming the internal mechanism of the disk drive. However, a diskette that has been magnetically erased by exposure to stray fields may be reformatted and returned to service.

In this section you will learn how to make some changes in a timbre. The timbre you will be changing is the sine wave that is automatically placed on the keyboard when you load the operating system. You are going to add vibrato to this sound and then vary the depth and rate of the vibrato.

You will use the VIBRATO RATE and DEPTH buttons, the control knob, the digital display window, and the pedal.

Once you select any musical parameter on the Synclavier® II control panel, such as vibrato depth or vibrato rate, you will find that as soon as you turn the control knob, you will hear the effect on the keyboard timbre.

Changing Vibrato Depth

1. Turn to the third panel of buttons and press the DEPTH button.

The DEPTH button will light up and a setting of .00 will appear in the digital display window. This number indicates the current vibrato depth setting in semitones. Thus, when you press a key on the keyboard, you will hear a sound with no vibrato.




By pressing the DEPTH knob button, you have assigned the vibrato depth function to the control knob.

2. Turn the control knob slowly to the right while pressing a key on the keyboard.

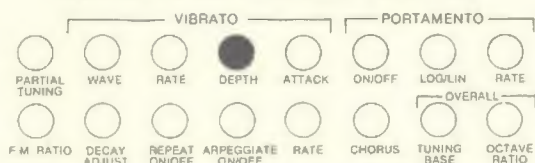
Vibrato depth will slowly increase as the numbers increase in the display window. A setting of 1.00 will create a fluctuation in pitch of one semitone in either direction from the pitch of the note played on the keyboard. The maximum vibrato depth is 24.00 semitones, a sweep from two octaves above to two octaves below the keyboard pitch.

The knob should be released fairly frequently. If you hold the control knob for a very long time without releasing it, the knob may appear to "unwind" as the numbers in the window continue to change even after you do release the knob. No harm is done to the system if this occurs. Just wait a few seconds and begin again.

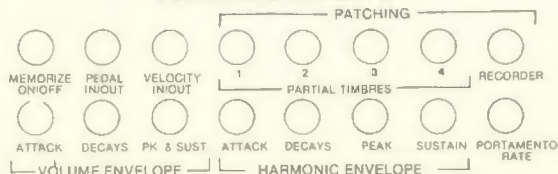
The following convention is used in figures throughout this manual.

Lit = 
 Blinking = 
 Unlit = 

KEYBOARD INSTRUMENT CONTROL



REAL TIME EFFECTS



Changing Vibrato Rate

1. Now press the RATE button under VIBRATO.

A setting of 6.00 will appear in the digital display window. This is the current vibrato rate in hertz.

Now, when you turn the control knob, you will change the vibrato *rate* rather than the depth. The last vibrato *depth* setting that you established in the window will remain in effect.

2. Turn the control knob to the left.

The vibrato rate will decrease. When the setting in the window is .00, you will hear no vibrato at all. To hear vibrato, then, you must have non-zero depth and rate settings.

3. Now turn the knob to the right.

You can dial any vibrato rate up to 50.00 hertz.

You have just learned the basics of timbre programming on Synclavier® II. You simply press the knob button for the aspect of the sound you wish to change and turn the control knob. The keyboard sound will instantly reflect the new setting. Each change is memorized by the computer as you move from function to function constructing the desired sound.

Later, in the section on "Designing New Timbres," you will learn, in detail, how to construct a timbre from periodic waveforms, volume and harmonic envelopes, and other musical modifications. In every case, you will use the knob buttons and the control knob.

Using the Pedal

The pedal can be used to control vibrato depth during performance. Note that the PEDAL IN/OUT button in the third panel is lit.

1. Connect the pedal VOLUME output to the jack labeled REAL TIME EFFECTS on the back of the keyboard unit.

2. Turn the pedal on and place it in the "down" position.

When the pedal is down, the vibrato will have the depth dialed in on the control knob.

3. Press DEPTH and dial a setting of 1.50.

The vibrato will be very strong.

4. Now gradually push the pedal up.

Vibrato depth will decrease. When the pedal is all the way up, there will be no vibrato.

5. Practice moving the pedal up and down while you play on the keyboard.

In the section on "Keyboard Control and Real-Time Effects," you will learn how the real time effects pedal can be used in the same way to vary volume and harmonic envelopes and portamento during performance.

RECALLING DIFFERENT TIMBRES

On the Synclavier® II system diskette, as well as on each timbre diskette, are stored 64 preprogrammed timbres. These timbres are ready for immediate recall at any time and will always sound exactly the same.

The timbres are organized into eight banks with eight timbres entries in each bank.

Timbre bank 1 is automatically placed in computer memory when you first load the Synclavier® II operating system. Timbre entry 1 in that bank (Timbre 1-1) is automatically placed on the keyboard. The BANK 1 and ENTRY 1 buttons in the fourth button panel are lit.

To activate another timbre in bank 1, just press a different TIMBRE ENTRY button. When you play any key on the keyboard, the new timbre will sound. Try pressing TIMBRE ENTRY button 2—the keyboard should sound like a church bell.

To load a different bank of timbres into computer memory, press one of the numbered buttons under TIMBRE BANK. The loading process takes the computer slightly more than a second. Loading a different bank does not change the keyboard timbre. To activate one of the timbres in the new bank, press a TIMBRE ENTRY button. Try pressing TIMBRE BANK 2 and then TIMBRE ENTRY 8—the keyboard will become a percussive instrument.



To play the timbres stored on a timbre diskette, simply remove the system diskette from the drive and replace it with the timbre diskette. Then access the new timbres in the usual way by pressing TIMBRE BANK and TIMBRE ENTRY buttons.

You should not press the LOAD button unless the *system* diskette is in the drive.

In a dual disk drive system, you may leave the system diskette in the left-hand drive and insert timbre diskettes in the right-hand drive. Then, to instruct the computer to read the new bank off the diskette in the right-hand drive, press the DRIVE SELECT button (located at the lower rightmost corner of the control panel) and *hold it down* while you press the BANK button.

You must press DRIVE SELECT every time you want to read a new bank off the diskette in the right-hand drive.

As you have explored the Synclavier® II timbres, you may have noted that each time you activated a new timbre a number from -1- to -8- appeared in the digital display window. This number indicates the number of voices used for that timbre.

Each Synclavier® II timbre consists of from one to four individually programmed sound components called *partial timbres*. Each partial timbre has its own harmonic content, attack and decay envelope, tuning, vibrato, etc. *One voice*, or synthesizer channel, is required to produce the sound of each partial timbre. Thus, playing a note in a timbre with three partial timbres requires three voices.

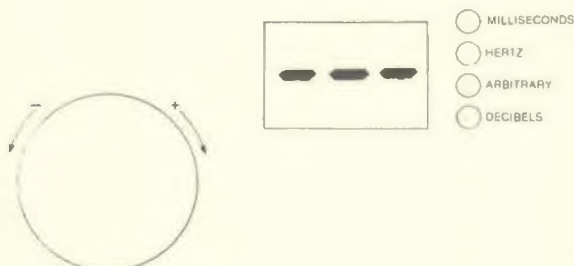
Chorus

The sound of a timbre can be enriched further by the chorus effect which duplicates the partial timbres with different tuning. The chorus effect doubles the number of voices required for the timbre. Thus, a note in a timbre with three partial timbres and chorus requires six voices.

Allocating Voices

Synclavier® II has a dynamic and flexible procedure for allocating these voices, assuring that if sufficient unused voices exist in your system, a new note will sound. Any free synthesizer voices are automatically assigned to play new notes, even if they have just been used to play notes with a completely different timbre.

This unique method of synthesis allows you to develop rich, complex sounds easily and to perform compositions using many different timbres simultaneously with the memory recorder.



Simultaneous Notes

You can play notes on the keyboard simultaneously until you use up all the voices in your system. By simultaneous notes, we mean all notes held down at the same time, not just notes that begin at the same time. If you have a 16 voice system, for instance, you can hold down 16 keys at the same time when Timbre 1-3 (a timbre with one partial timbre) is active on the keyboard. If you try to press a 17th key, "bars" will appear in the digital display window which warn you that you are out of voices.

Final decays, that portion of the note that occurs after you release a key, will be cut off if necessary to free up voices for a new note.

Timbre 1-2 has four active partial timbres. Each time you play a note in this timbre, you use up four voices. If you have a 16 voice system, for example, you can simultaneously play four notes with this timbre.

"Bars" will appear when you try to hold down the fifth key.

This timbre also has long final decays which are automatically cut off as necessary to play new notes. In other words, you can play a fifth note as soon as you release the first, even though the first note is still in final decay.

Timbre 2-1 also has four active partial timbres. But, unlike Timbre 1-2 where the number of simultaneous notes is limited only by the number of voices in your system, this timbre has been programmed to be monophonic. Only one note of this timbre can sound at a time. You will find that fast runs and trills are much cleaner in this timbre, because all final decays are cut off as soon as you press a new note. But "bars" will appear in the digital display window if you attempt a chord.

The Synclavier® II keyboard polyphony control allows you complete control over the number of notes that can play simultaneously. For details, see the section on "Designing New Timbres."

USING THE PARTIAL TIMBRE SELECT BUTTONS

Since a timbre on the keyboard may have from one to four partial timbres, the PARTIAL TIMBRE SELECT buttons have been provided so that you can select which partial timbre or partial timbres will be modified with the knob and which ones will be heard on the keyboard.

These buttons have been efficiently designed so that they can be used for several related functions. Their particular use depends on whether they are lit, blinking, or unlit.

The Blinking and Lit States

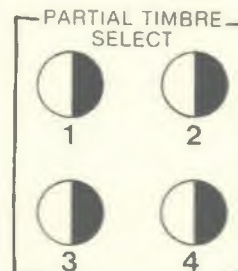
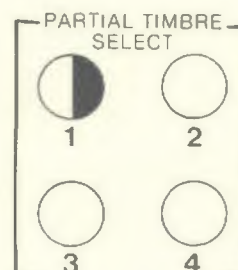
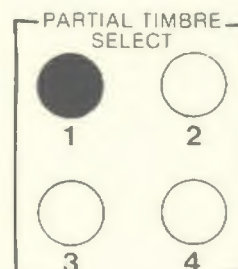
Normally, you will hear all active partial timbres when you play a note. However, when a PARTIAL TIMBRE SELECT button is blinking, *only* that partial timbre will be heard when you press a key on the keyboard.

When a PARTIAL TIMBRE SELECT button is lit or blinking, the values for that partial timbre will appear in the digital display window when you press a knob button. Any programming you do with the knob will affect that partial timbre.

If more than one PARTIAL TIMBRE SELECT button is blinking, more than one partial timbre will be heard on the keyboard. Similarly, if more than one button is lit or blinking, more than one partial timbre will be affected by any changes made with the knob.

There is a special case. When *all four* buttons are blinking, keyboard polyphony control is activated. The knob is then used to set the keyboard polyphony. (See "Designing New Timbres.")

At all times at least one PARTIAL TIMBRE SELECT button will be lit or blinking.



Using the Buttons

Practice pressing the PARTIAL TIMBRE SELECT buttons to see how they operate.

When you press a lit PARTIAL TIMBRE SELECT button, it will start blinking. When you press a blinking PARTIAL TIMBRE SELECT button, it will stop blinking and become lit. When you press a different PARTIAL TIMBRE SELECT button, it will assume the same state as the previous button which will simultaneously become unlit. To make more than one button blink or become lit, press the desired buttons simultaneously.

Finally, when you recall a new timbre, you will not change the state of the PARTIAL TIMBRE SELECT buttons.

By running through the following exercise, you will learn about the PARTIAL TIMBRE SELECT buttons and about the construction of timbres from separate sounds.

Recall Timbre 2-2. You will see in the digital display window that this timbre consists of three partial timbres.

1. Make sure that button 1 under PARTIAL TIMBRE SELECT is lit.

(This button is automatically lit when the operating system is first loaded.)

When you press a key on the keyboard, you will hear a complex sound consisting of three partial timbres.

2. Press button 1.

Button 1 will start blinking. When you press a key on the keyboard, you will hear only the piano-like sound of partial timbre 1.

3. Press button 2.

Button 2 will start blinking; button 1 will become unlit. You will hear only partial timbre 2, a completely different sound.

4. And button 3 . . .

You should hear an octave trill.

5. Now press button 4.

This time, when you press a key on the keyboard, there will be no sound and "bars" will appear in the digital display window. This is the signal that a partial timbre is not being used. (This means that both the peak and sustain volume levels are 0 for partial timbre 4. The volume envelope is explained later in the section "Designing New Timbres.")

6. Now press button 1 twice.

Button 1 should be lit. When you press a key on the keyboard, you will hear the complete timbre again.

Different timbres may behave quite differently when played on the keyboard, depending on how their volume and harmonic envelopes have been programmed.

The sound of each timbre may be divided into three basic time segments: the attack, the sustain, and the final decay. The actual programming of these segments will be covered later, but to get a feel for the flexible nature of the Synclavier® II keyboard, activate each of the following timbres on the keyboard and try playing them.

Timbre 2-8

This percussive timbre has no volume envelope sustain. All the sound comes from the attack segment. Even if you leave your finger on a key, the note will cut off very quickly.

Timbre 3-1

The quicker you play this bell-like timbre, the longer the sound will ring out. This paradoxical effect is due to the fact that there is no volume envelope sustain, but there is a long final decay which will be heard if you release the key during the attack segment of the sound. If you hold down the key longer than the attack segment, the final decay will not sound.

Timbre 3-6

With this timbre, as you hold down a key, the brightness, or harmonic content, of the sound will change. That is because the harmonic envelope has been programmed to provide FM during the attack segment of the sound, but not during the sustain.

Timbre 3-8

This violin-like sound has full volume in the sustain segment and a very short final decay. It will sound as long as your finger is on the key and will cut off as soon as you lift your finger. Listen to the rich sound of this timbre. It uses eight voices: four partial timbres plus chorus.

Timbre 7-1

Synclavier® II gives you complete control over peak level, or volume of the attack of the sound. This timbre has a zero peak level. The volume *rises* from peak to sustain level. If you press a key again while the previous note is in final decay, the volume will have to come *down* before it can rise again. As you continue to press the key, the note will swell in volume, similar to the bowing of a violin. However, this timbre is difficult to trill.

There are many other special timbral effects which you will hear as you continue recalling and experimenting with the timbres.

The Synclavier® II 16-track memory recorder uses computer memory instead of recording tape to record sound. Although the operation of the memory recorder will seem quite familiar if you have used a tape recorder, you will find important features unavailable on analog equipment.

All notes are memorized just as you play them on the keyboard. You can record up to 16 different timbres on 16 different tracks and then play back all or any tracks in perfect synchrony.

Any sequence in the memory recorder is only a temporary working copy. It will be lost whenever you turn off the computer, recall a different sequence from the diskette, or press the ERASE button twice. For a permanent copy which you can recall, play back and embellish at any time, you may quickly store the sequence on diskette.

This introductory chapter will give you the feel of memory recorder operation.

PLAYING "Scarborough Fair"

In the first group of exercises, you will recall a demonstration sequence from the diskette and play it back. You will also solo the individual tracks and substitute a different timbre on one of the tracks.

NOTE: When the Synclavier® II operating system is first loaded, the click track output will be heard during recording or playback. To avoid being distracted by the click track output at this time, press the CLICK RATE button twice to make it blink. The click track output will become inaudible. Details about the click track are covered in the section on "Using the Memory Recorder."

Recalling a Sequence and Playing It Back

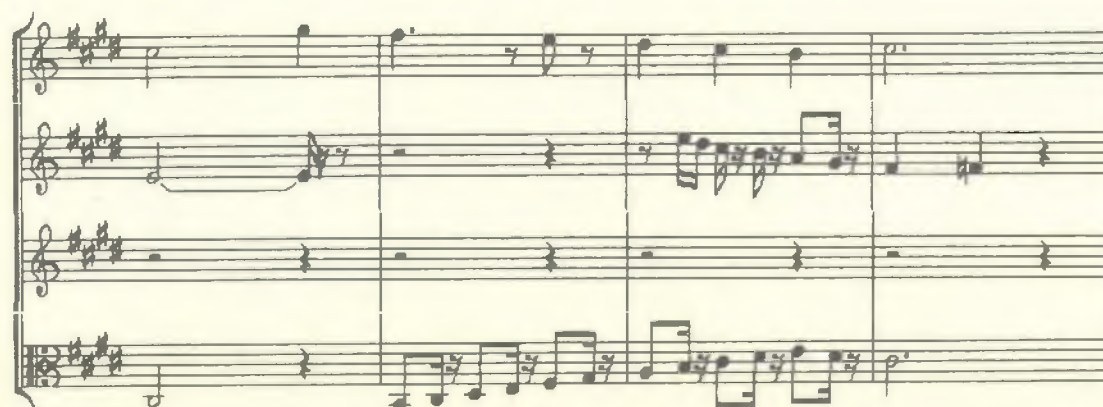
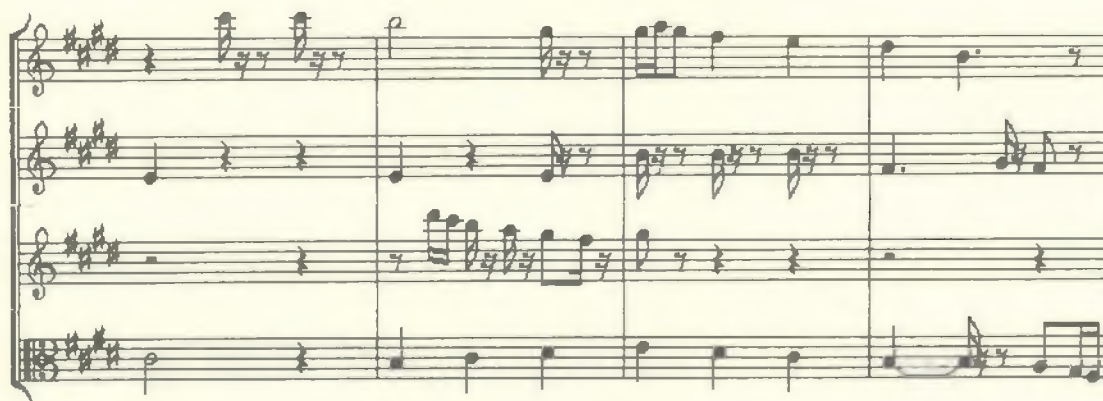
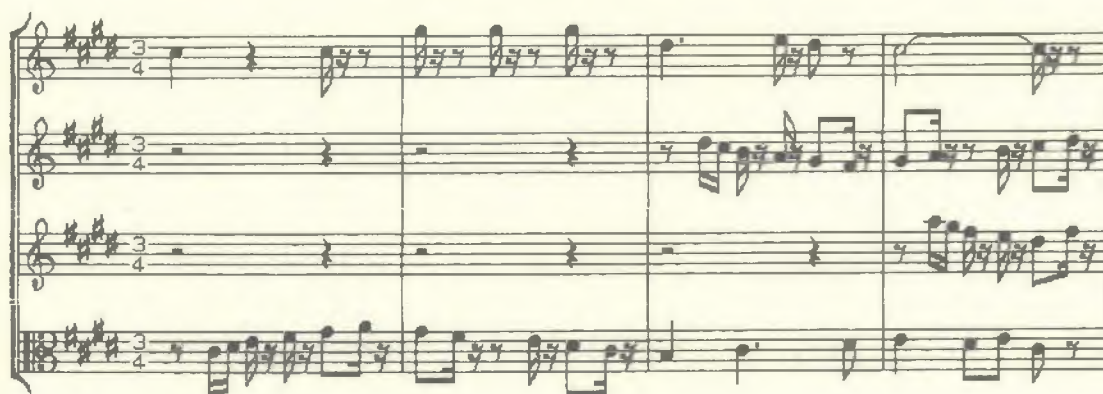
1. Press button 1 under RECORDER STORE/RECALL (located on the lower right panel of buttons).

This instructs the computer to read sequence-1, "Scarborough Fair," from the system diskette and to place it in the memory recorder. Note that "Scarborough Fair" is only on Release F or later of the Synclavier® II operating system.

The number in the digital display window indicates the number of notes you could add to this sequence if you wished to. This number depends on the amount of memory in your system. (Additional memory boards can be purchased from New England Digital to expand this limit.)

The LOOP button in the central panel will light up. That means the sequence has an overall loop on all tracks in the sequence.

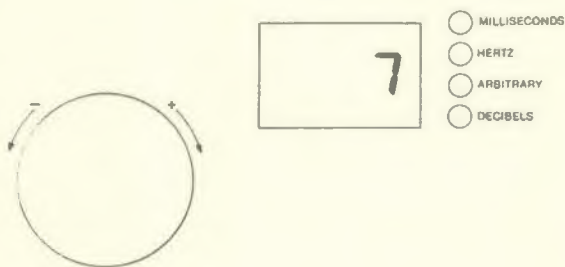
Scarborough Fair



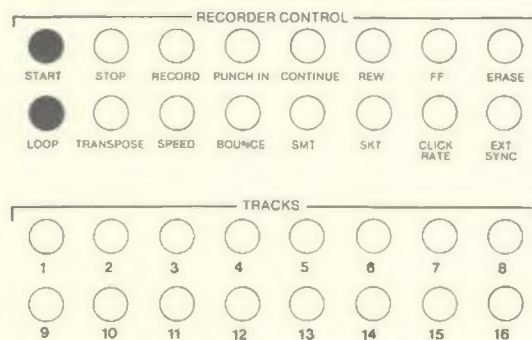
2. Press START once.

In the digital display window you will see the beats of the digital metronome counted at a rate of 120 beats per minute. "Scarborough Fair" is in 3/4 time with one beat of the metronome per quarter note. After a rest of six beats, the sequence will begin to play. It will continue to play until it reaches a loop point when it will return to the first note and start over.

The beats will count up to the beat number of the loop point and then return to the beat number of the first note in the sequence. Since there is a two measure (six beat) rest at the beginning, the sequence will loop back to beat 7.



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3. While the sequence loops, press STOP.

The memory recorder will stop playing.

4. Now, press CONTINUE.

The sequence will be played from the point where you pressed STOP, rather than from the beginning.

5. Press STOP.

6. Now press START twice.

The recorder will skip over the rest and begin on the first note. The beats will start counting from beat number 7. Pressing START once starts playback with the first beat; pressing START twice starts with the first note. This alternative usage has been included so that you can skip over count-off measures.

Moving Forward and Backward

The F.F. (fast forward) and REW. (rewind) buttons work just as they would in standard tape recorders. Press F.F. to move quickly to a forward point in the sequence; press REW. to return to an earlier point. When you reach the desired point, press STOP. Use CONTINUE to play back from any point in the sequence but the beginning. Use START to play back from the beginning.

Soloing Tracks

To "solo" means to isolate one or more tracks from the overall group of 16 tracks. Soloed tracks can be listened to individually or in any combination.

"Scarborough Fair" has been recorded on four tracks (1 through 4). All notes on a track have the same timbre.

1. Press START.
2. While the sequence is looping, press button 1 under TRACKS.

Button 1 will start blinking. Only the notes recorded on track 1 will be audible.

3. Press button 2.

Button 2 will start blinking; button 1 will stop blinking and will remain lit.

Now you will hear the notes recorded on track 1 and 2.

(The blinking and lit states of button 1 and button 2 have to do with recording. In playback, the lit or blinking state means the same thing.)

4. Press button 1 again.

Button 1 will go out and you will hear only the notes on track 2.

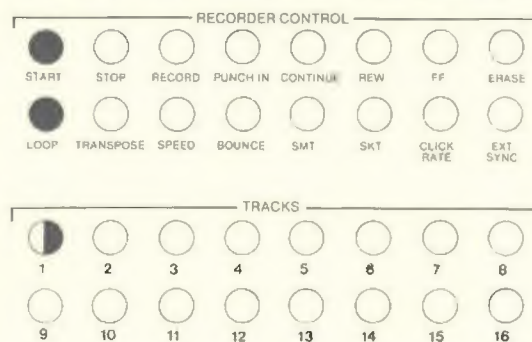
5. Press button 2 again.

All TRACKS buttons will be out. You will hear all tracks.

6. Try soloing track 3 and track 4.

To summarize, when all TRACKS lights are out, all tracks will be heard when the sequence is played. When any TRACKS buttons are lit or blinking, only the selected tracks will be heard. To "unsolo" a track, press the TRACKS button a second time.

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Substituting Timbres

You can substitute a new timbre for the timbre used on a track and thus play the same notes with a new instrument. In the following exercise you will first substitute Timbre 3-7 (a flute-like sound) for the timbre on track 1.

Do the exercise while the sequence continues to loop.

1. Press TIMBRE BANK 3.

This bank contains the timbre you are going to substitute.

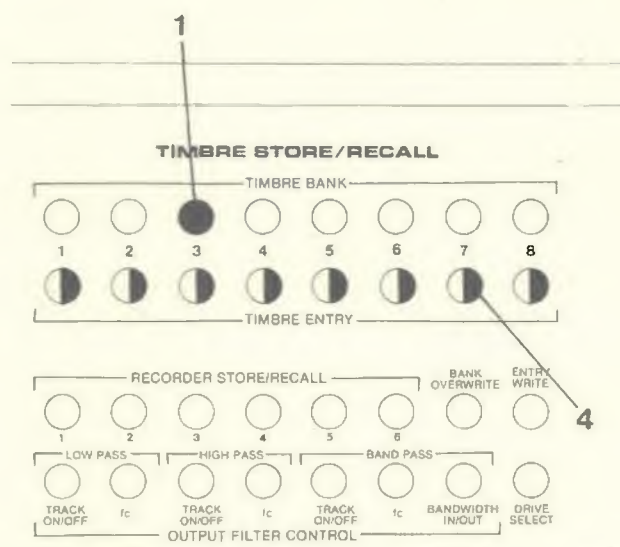
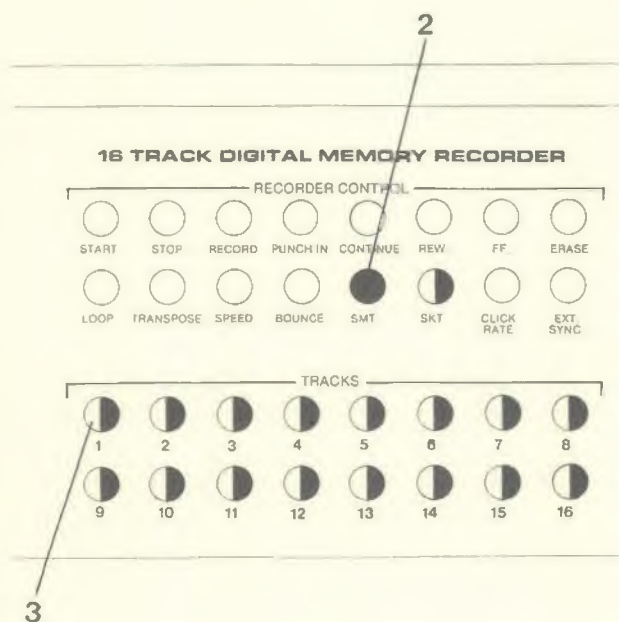
While the bank is being loaded into the Synclavier® II computer, the recorder will pause.

2. Press SMT.

The SMT (select memory timbre) button will light up and all 16 TRACKS buttons will start blinking. The memory recorder is asking you which track you wish to change.

3. Press button 1 under TRACKS.

The 16 TRACKS buttons will continue to blink. The SKT and the TIMBRE ENTRY buttons will start to blink. The recorder is asking you whether you want to change to a timbre that is used on another track (TRACKS), to the timbre that is active on the keyboard (SKT), or to a timbre that is stored in the timbre bank in computer memory (TIMBRE ENTRY). In this case, you are going to change to a timbre in the bank.



4. Press TIMBRE ENTRY 7.

The notes on track 1 will be played with Timbre 3-7.

5. Try substituting other timbres on this and other tracks in the sequence.

You can substitute timbres either when the recorder is playing or when it is stopped.

RECORDING

In the next group of exercises you will record your own sequence on two tracks, establish an overall loop, and transpose the sequence.

Note: If you begin experimenting during recording, it is possible you may produce an Error Message in the display window. No harm is done if this happens. For a complete summary of error messages, see the Appendix.

Recording Your First Track

1. Press ERASE twice.

The temporary copy of the sequence in the memory recorder is erased. The permanent copy on the diskette has not been erased (nor has it been affected by the timbre substitutions).

2. Recall Timbre 4-1 and play with it for a moment to familiarize yourself with it.

3. Press RECORD and play some notes.

The START button will light up. The RECORD button and button 1 under TRACKS will start blinking. The computer will automatically select the first empty track in the recorder on which to record your notes. Thus, when the recorder is empty, it always selects track 1.

4. When you're finished with your sequence of notes, press STOP.

Your notes have now been recorded on track 1 of the memory recorder.

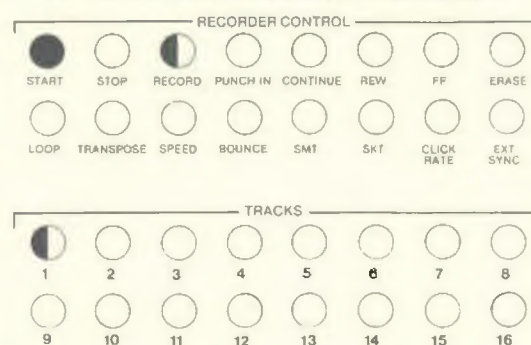
The number in the digital display window will indicate the number of notes that you may add to your sequence before you exceed the memory capacity of the computer.

5. Press START once.

The beats will start counting in the window again. You will hear that everything you played on the keyboard has been memorized in relation to the beat of the digital metronome.

6. When your sequence has finished playing, press STOP.

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Overdubbing on the Same Track

To overdub means to add more notes to a sequence without erasing recorded notes. In this exercise, you will learn to add notes in the same timbre to the same track.

1. Press RECORD.

The START button will light up and remain lit. The RECORD button will start to blink as will button 1 under TRACKS, because the keyboard timbre and the timbre for track 1 are the same.

The first recorded notes will be played.

2. Play along with the recorded notes.

Your new notes will be added to the original material on track 1.

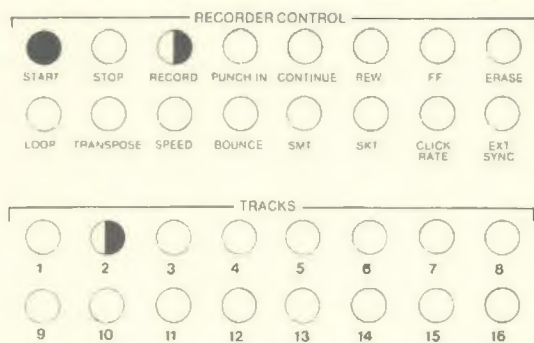
3. When you're finished recording, press STOP.

The digital display window should display fewer notes.

4. Press START to play the new sequence.

It is also possible to record new notes in the same timbre on different tracks. Just press the button for the new empty track before recording.

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Overdubbing on a Second Track with a New Timbre

1. Recall Timbre 3-7 to the keyboard.

2. Press RECORD.

Several things will happen. The START button will light up. The RECORD button and button 2 under TRACKS will start blinking. Each time you select a new keyboard timbre, the computer will automatically select a new empty track for recording. The notes on track 1 will be played back.

3. Play along with the music recorded on track 1.

4. When you're finished recording, press STOP.

5. Press START.

You will hear the notes on track 1 and track 2. Solo the tracks if you like.

Erasing and Editing

If you want to erase the entire sequence, make sure all the TRACKS buttons are unlit and press ERASE twice.

If you want to erase just one track, solo that track and then press ERASE twice.

You can also erase only a few notes on a track with the PUNCH IN button. Details are covered in the section on "Using the Memory Recorder."

Editing of notes with surgical precision may be accomplished on a computer terminal with the Script system.

Establishing a Loop

1. Press START and after a few notes press LOOP.

The LOOP button will light up and the recorder will instantly go back to the first note in the sequence and begin to play again. It will play until it reaches the loop point (the point in the sequence where you pressed LOOP) and then return to the beginning again. The recorder will continue "looping" over and over again automatically.

You can see the loop in the window. The beats will count up to the beat number of the loop point and then return to the beat number of the first note in the sequence, *not* to beat 1.

2. Press STOP and then START.

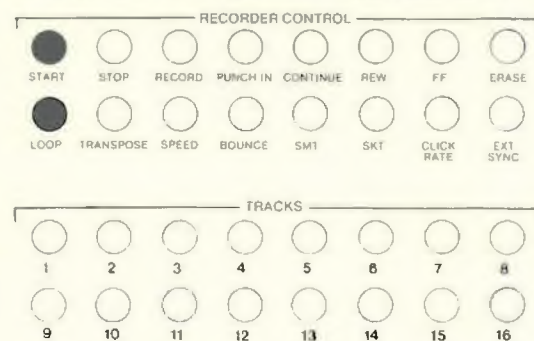
You will see that the loop has been memorized. Your sequence will begin at the beginning, play to the loop point, and then start looping.

3. Now press LOOP.

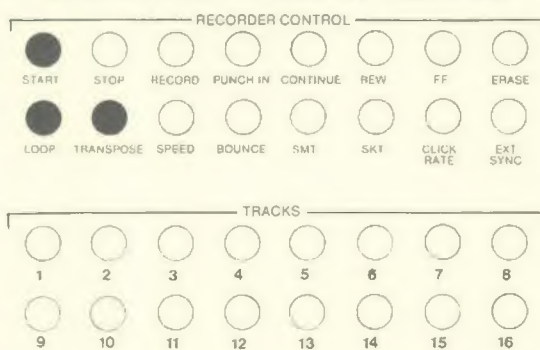
The LOOP button will go out and the recorder will play the sequence past the loop point. The loop is gone.

You may place loops on individual tracks, loop back to a point in the middle of a sequence (*Dal segno*), or align the loop point precisely with the beat of the track. Details are covered in the section on "Using the Memory Recorder."

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Transposing Your Sequence

When the TRANSPOSE button is lit, the keyboard is used, not to play notes, but to transpose the sequence.

This exercise may be performed conveniently if you first place a loop on your sequence.

1. Press TRANSPOSE while the sequence is looping.

The TRANSPOSE button will light up and stay lit.

2. Press E above middle C on the keyboard.

Your sequence will be instantly transposed up a major third. The Synclavier® II computer calculates all transpositions from a root of middle C. It will take the interval (or the number of semitones) between the note you play and middle C and transpose all notes in the sequence up or down that exact interval. The transposition will be strict, rather than tonal. When you pressed E, you indicated an interval of a major third (four semitones).

3. Press G below middle C.

The sequence will again be instantly transposed from its original key, this time down a perfect fourth.

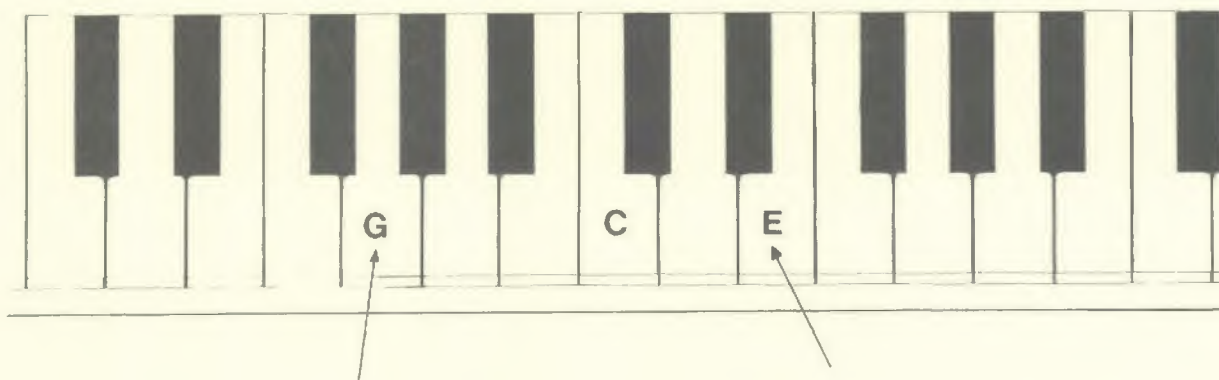
4. Press middle C.

The sequence will be returned to its original key.

5. Press TRANSPOSE.

The TRANSPOSE button will go out and you may now play on the keyboard without causing transpositions.

You can also transpose individual tracks. For details on that function and for instructions on the many other possibilities for multitrack recording and for sequence modification, see the section on "Using the Memory Recorder."



You have now completed a brief tour of Synclavier® II. The remaining sections in the manual may be read in any order.

II. USING THE MEMORY RECORDER

In the introductory section you became familiar with the basic operation of the Synclavier® II memory recorder. You learned to recall a sequence from the diskette, to play it back from the beginning (START) or from midpoint (CONTINUE), to stop playback or recording (STOP), and to use the fast forward (F.F.) and rewind (REW.) functions. You also learned how to solo tracks, loop, transpose, substitute timbres, and erase.

In this section, you will learn further details about multitrack recording: using the click track, bouncing down tracks, and correcting mistakes. You will also learn more ways to modify the sequence in the memory recorder. Finally, you will learn how to save your sequences on diskette.

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Modifying Sequences	40
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The Synclavier® II memory recorder allows you to record on up to sixteen tracks. You record on one track at a time, building a complex sequence with a different timbre on each track. This chapter gives you some background on the number of notes you may record. Both the maximum number of notes in the entire sequence and the number of notes that may play at any one time are discussed.

MAXIMUM NUMBER OF NOTES

The maximum number of notes that you will be able to record in one sequence will depend on the amount of computer memory installed in your system. The following table lists the maximum number of notes with various amounts of memory.

Computer Memory (words)	Memory Recorder (notes)
32K	1000
40K	4800
48K	8000
56K	9999

These numbers reflect the maximum number of notes if you are using the Release F operating system.

ALLOCATION OF VOICES

During the recording and playing of complex musical passages, Synclavier® II performs an extremely sophisticated allocation of system resources. Up to eighteen timbres can play at one time: one on each of the sixteen tracks in the memory recorder, and two on the real-time keyboard. (Using the split keyboard is covered in the section on "Keyboard Control and Real-Time Effects.")

In the introductory chapter, you learned that you can only play on the keyboard as many notes simultaneously as you have voices, and that each timbre can require up to eight voices (four for the partial timbres and four more with the chorus effect) for each note.

The same is true when you use the memory recorder. In this case, however, the simultaneous notes can be in different timbres on different tracks. You can divide up the notes any way you want. For example, in a 32 voice system, you could record 32 simultaneous notes all on the same track using a timbre with one voice. Or you could record four simultaneous notes on four different tracks each one in a different eight-voice timbre. It's the total number of voices that counts.

When you press a key and there are no voices available to play it, the note will not sound, and will not be recorded, until the notes on different tracks have completely finished their final decays. Then, the synthesizers will be released for use with your new notes.

Final Decays of Notes on Different Tracks

In determining the number of voices in use, you have to consider the final decays of the notes you have recorded on different tracks.

When you *add* notes to a track, the computer will free up voices for the new notes by cutting off the final decays of notes recorded on that track.

But, it will not cut off the final decays of any notes recorded on different tracks.

In general, notes played with timbres with long final decays will use up a lot of voices and will limit the number of additional notes you can record simultaneously on other tracks in the recorder.

If you wish to use long final decays in a multitrack sequence, it would be wise to record the tracks with timbres with short final decays first and save the track with a timbre with a long final decay for the last "layer" in the recording session.

Keyboard polyphony control can also be used to limit the number of voices used by notes with long final decays. (See "Designing New Timbres.")

As in real time, "bars" will appear in the digital display window when you are out of voices in the memory recorder.

Hocketing

By "hocketing" between tracks, you can use the synthesizer voices efficiently and increase the number of different timbres in a sequence. With this technique, you alternate between different tracks, with one part sounding while others rest. The end result is a very rich sound, economically created.

Recall and play sequence 2 off the system diskette (press button 2 under RECORDER STORE/RECALL) for an example of the hocket technique.

This chapter describes the click track, additional overdubbing techniques, the merging of tracks, and the correcting of mistakes.

THE CLICK TRACK

The click track output is the audio output of the digital metronome and is used to synchronize recording on more than one track. The CLICK RATE button is used as a *function* button to turn the click track output on and off. It is also a *knob* button used to adjust the click rate.

If you have not already done so, connect the click track output to the sound system through a mixer as described in the Setup Manual.

Turning the Click Track Output On or Off

You may control the audibility of the click track output with your mixer. In addition, you may turn it on and off with the CLICK TRACK button.

When the CLICK RATE button is lit, the click track output will be audible during playback or recording. When the CLICK RATE button is blinking, the output will be inaudible. The lit or blinking state of the CLICK RATE button is retained in memory, even when you turn the button out by pressing a different knob button.

For example, when you first load the system, the audible, or lit, state for the click track will be placed in computer memory even though the CLICK RATE button is not actually lit. When you press the CLICK RATE button once, the button will light up and the output will remain audible. If you press another knob button, such as the SPEED button, the CLICK RATE button will go out. But the click track output will remain audible.

If you press CLICK RATE twice, and make it blink, the output will become inaudible. Pressing a knob button will turn the CLICK RATE button out but the blinking, or inaudible, state for the click track will remain in effect.

Adjusting the Click Rate

When you first load the operating system, the click rate will be 120 clicks per minute.

You can adjust this rate from a maximum of 2400 clicks per minute to a minimum of 6.0 clicks per minute. To do so, press the CLICK RATE button so that it's lit and press START to hear the output. Turn the control knob to the right to speed up the rate and to the left to slow it down.

When you erase a sequence, you will not erase the current click rate. And when you store a sequence, the current click rate will be stored along with it.

MORE ABOUT OVERDUBBING

You learned the principles of Synclavier® II recording in the introductory section. To review, when you press RECORD, the recorder will first search for a track that has notes recorded on it in the same timbre as is active on the keyboard. If it finds such a track, your new performance will be merged with the existing notes on that track.

If the keyboard timbre is not found on any track, the memory recorder will select the first empty track for your new performance.

The track on which you are recording will always have a blinking button.

Overdubbing with the Same Timbre on a Different Track

By soloing a track and making its button blink, you can override the computer's automatic track assignment and record the *same* timbre on a *different* track.

There is a distinct advantage to this method. Suppose you're overdubbing on one track and everything is doing just fine until the fourth overdub. Halfway through this overdub you make a mistake. It's extremely difficult to correct that mistake without erasing all the performances in that spot on the track. (Except with the Script system.)

On the other hand, if you record each performance on a different track, you can easily correct a mistake on one track without disturbing the other tracks. When you get all your performances just right, you can bounce, or merge, them all down to one track.

NOTE: Merging tracks and correcting mistakes will be covered shortly.

The following exercise demonstrates use of the click track and the new method of overdubbing.

1. Establish a click rate suitable for recording multiple performances.
2. Select a timbre and record a sequence on track 1, as you have done before. But this time let eight clicks go by before playing. These eight clicks will be used as a count off when you record your second track.

Eight is an arbitrary number selected for demonstration purposes. The number of clicks used for a count off at the beginning of a recording is, in fact, always determined by you. You can use as many or as few clicks as you wish. And, of course, you don't have to use the click track at all.

3. When you're finished recording, press STOP.

The number of notes remaining in the memory recorder will appear in the digital display window.

4. Play back your sequence by pressing START.
5. Press STOP.
6. If you want to skip past the clicks at the beginning, and begin with the first note, press START *twice*.
7. And, if you want to hear the music without the clicks, make the CLICK RATE button blink.

8. Now press button 2 under TRACKS.
Button 2 will start blinking.
9. ... and also the CLICK RATE button (so that you can hear the clicks while recording).
10. Press RECORD and play along with the click track and with the notes on track 1.
The notes that you play will be recorded on track 2.

Save this sequence for use with the BOUNCE exercise.

Another Overdubbing Technique

You cannot record different timbres on the same track. To the computer a different timbre is one with the *slightest* difference in any of the settings that make up the timbre. By making a very small and inaudible change in some setting of a timbre, you can guarantee that the recorder will automatically use a new track for recording. Your ears cannot hear a one milli-second change in attack time, but to the computer, it's a completely different timbre.

If you use this method, you will not be able to bounce the tracks down onto one track without first replacing the changed timbres with the original timbre. This is easily accomplished with the SMT button using the procedure described in the next chapter.

A Useful Technique for Long Sequences

Some composers like to record a long rest followed by a single note on one track of their sequences. Then by soloing this track and pressing START twice, it is possible to jump to a specific point in the middle of the sequence.

Error Messages

An error message is a special display that appears in the digital display window when the computer cannot complete your instructions because of some minor error. Nothing is lost from memory when this happens. After correcting the error, you can continue as usual.

Two error messages you may run into while recording are: Err7 and Err8. (All error messages are listed in the Appendix.)

Err 7

Err7 will appear when the track you have soloed before pressing RECORD is not empty, but contains some notes recorded in a timbre different from the timbre active on the keyboard. You must select a different track to record on, or change the timbre on that track with the SMT button.

Err 8

Err8 will appear if there are no free tracks when you press RECORD. You must either erase a track or change one of the tracks to the same timbre as active on the keyboard.

BOUNCING DOWN TRACKS

You use the BOUNCE button to merge the notes recorded on one track onto another. You can bounce, or transfer, the notes to any empty track or to any track with recorded notes in the exact same timbre.

There are two kinds of bounces. In the first, you bounce the notes from one track onto another and simultaneously erase the originating track. In the second, you bounce the notes onto another track but do not erase the originating track.

Try the following exercises with the sequence you just created. It should have notes on two tracks and both tracks should use the same timbre.

Erasing Bounces

1. Press BOUNCE.

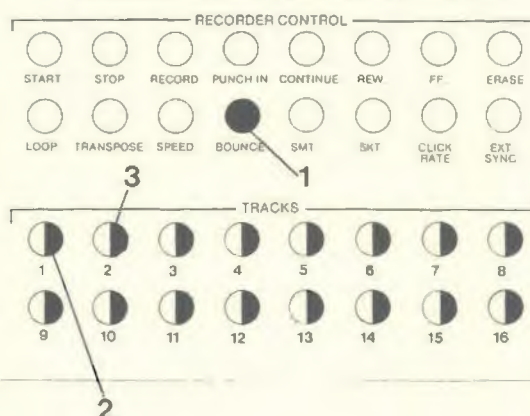
The BOUNCE button will light up and the 16 TRACKS buttons will begin blinking. The recorder is asking you which track you want to bounce.

2. Press button 1 (the originating track) *once*.
3. Press button 2.

All 16 TRACKS buttons will go out. The notes on track 1 will be merged with those on track 2. Track 1 will be erased.

4. Solo and play the two tracks to check this out.

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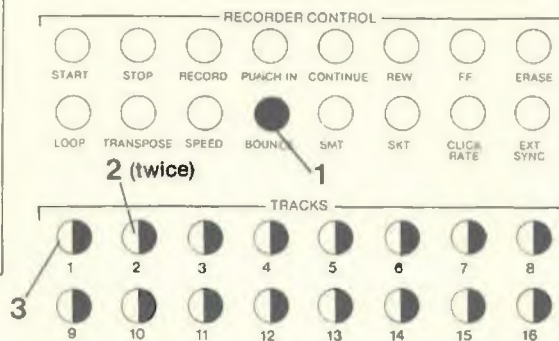
Nonerasing Bounces

1. Press BOUNCE again.
2. Press TRACK 2 (the new originating track) *twice*.
3. Press TRACK 1.

All 16 TRACKS buttons will go out. Track 1 and track 2 now have the same sequence recorded on them.

Solo and play track 1 and track 2 to check this out.

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More Error Messages

You may meet up with two new error messages when you are bouncing tracks: Err9 and Err0.

Err 9

When Err9 appears in the window it means that the timbre on the originating track is not the same as the timbre on the track you are bouncing to. You will have to change one or the other.

Err 0

The Err0 message can appear when you're bouncing long sequences onto additional tracks without erasing. It means the memory recorder is out of notes. The only solution is to erase some notes.

USING PUNCH IN

The PUNCH IN button allows you to erase a note or notes in the middle of a sequence on one track. At the same time it allows you to replace the erased notes with new notes.

During playback, you press PUNCH IN to start erasing and recording on the track with the blinking light. Then, to stop erasing and recording, you press PUNCH IN a second time.

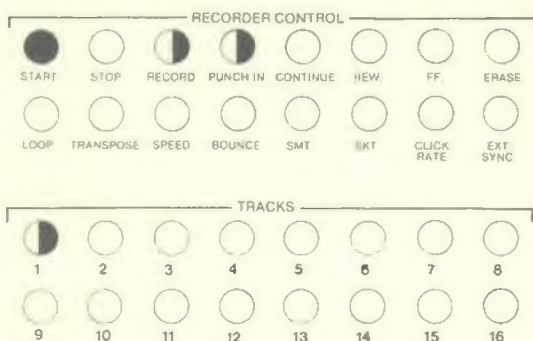
Since pressing PUNCH IN turns on the RECORD button, all the rules that apply to recording are in effect. Even if you only wish to erase notes and do not wish to record new ones, the keyboard timbre must be the same as the blinking track.

The memory recorder will not begin erasing in the middle of a note. If you press PUNCH IN between two notes, the erasing will begin immediately. If you press PUNCH IN on top of a note, the erasing will begin right after the note ends.

The same is true for stopping erasing. If you press PUNCH IN the second time during a held note, the recorder will not stop erasing until the note ends. The complete note will be eliminated.

Recording, on the other hand, will commence as soon as you press PUNCH IN and will stop as soon as you press it a second time.

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Using PUNCH IN to Erase Only

Read this through before beginning. Several things have to be done very quickly.

1. Record a new sequence on track 1.
2. Press START.

The recorder will begin to play back.

3. Now, after a few notes, press PUNCH IN.

The PUNCH IN button, the RECORDER button, and button 1 under TRACKS will start to blink. The memory recorder is erasing the material on track 1. You will hear nothing played back.

4. After a beat or two, press PUNCH IN again.

The PUNCH IN and RECORD lights will go out. The recorder will continue to play back without erasing.

5. Press STOP.
6. Press START.

There will be a gap of one or two beats in the middle of the notes.

You can also use the STOP or CONTINUE buttons to stop erasing. With the STOP button, of course, you will also stop the play back.

Using PUNCH IN to Erase and Record Simultaneously

This time use the click track.

1. Erase the previous sequence and record another. Allow eight beats before playing and then play in time with the click track.
2. Press START.
3. Play back a few bars and then press PUNCH IN.
4. Play some new notes, keeping in time with the click track.
5. Then press PUNCH IN again.
6. Play back the changed sequence.

You can also start erasing and recording at the very beginning of a track by pressing PUNCH IN *before* pressing START. Stop at any point as usual.

If your sequence is recorded on more than one track, the memory recorder will automatically erase and record on the first track with the keyboard timbre on it. Or, you can solo a different track before you press PUNCH IN.

In this situation, when you press START, you will hear only the soloed track. When you press PUNCH IN, you will hear all other tracks as you erase and record. When you press PUNCH IN the second time, you will again hear only the soloed track.

If you ever press PUNCH IN and the timbre on the track with the blinking button is different from the timbre active on the keyboard, you will get an Err7 error message. To correct the error, you can use the SKT button to make the timbre on the track you wish to change active on the keyboard (see instructions in next chapter). Then press PUNCH IN.

Note that the SCRIPT system allows you to do extremely precise editing on the computer terminal. You can correct bad notes, as well as add and remove notes and rests.

Using the Foot Switch to Punch In

A switch on the pedal can be used quite effectively to activate the PUNCH IN function, freeing your hands for the keyboard. Connect one of the foot switch outputs to the jack labeled PUNCH IN/OUT FOOT SWITCH on the back of the keyboard unit.

When you push the foot switch once, the recorder will start erasing and recording. (You don't have to keep your foot on the foot switch. Just push it once and release.)

To stop erasing and recording, push the foot switch again.

MODIFYING A RECORDED SEQUENCE

As you learned in the introductory section, many of the buttons in the central panel are used to modify recorded notes. Such modifications are memorized by the computer, but will only affect the temporary, working copy of the sequence in the memory recorder. The sequence stored on the diskette will remain in its original form, unless you deliberately replace it by the storage procedure described in the next chapter.

"Scarborough Fair" is designed to work well with all the modifications. Before doing each exercise, recall this demonstration sequence off the diskette by pressing button 1 under RECORDER STORE/RECALL. (The sequence is found only on Release F or later system diskettes.)

CHANGING THE SPEED

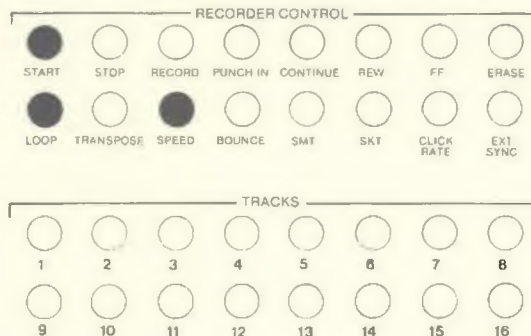
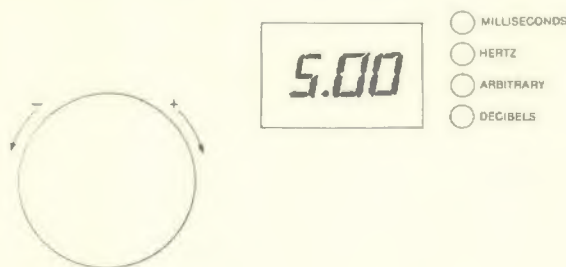
In the Synclavier® II memory recorder, you can change the playback or recording speed without changing the tuning. You use the SPEED button and the control knob.

Recall "Scarborough Fair" and try the following exercise.

1. Press START and while the sequence loops, press SPEED.

The SPEED button will light up. The number 1.000 in the digital display window indicates that the sequence is being played at its original speed, that is, at 1.000 times its original speed.

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2. Turn the control knob to the left.

As the numbers in the window decrease, the speed of the sequence will begin to slow down.

When you turn the knob all the way to the left, the number in the window will be .000, and the sequence will be at a complete standstill.

3. Turn the control knob to the right.

As the numbers in the window increase, the speed of the sequence will begin to quicken. When you turn the knob all the way to the right, the number will be 10.00, which means the sequence is being played at ten times the original speed.

At extremely fast playback speeds, some sounds in the sequence will not have a chance to complete their attack and decay segments and the sound will become muffled and indistinct. Adjust your speeds accordingly.

4. Press SPEED twice.

This will return the SPEED setting to 1.000 and the sequence to its original speed.

It is possible to speed up a recorded sequence by a factor even greater than 10. Before recording the sequence, set the speed setting to less than normal speed, for example, 0.10. Then record in the usual manner. After recording, turn the speed up to 10.00. When you play the sequence back, it will be at 100 times the rate that it was recorded. This procedure may be used to provide a tempo range of from 1000/1 to 1/1000—one million.

NOTE: When you change the SPEED setting for a sequence, the click track will be automatically adjusted to keep the digital metronome in time with the sequence. The click rate that appears in the window when you press the CLICK RATE button does not change. It always indicates the rate when the SPEED setting is 1.000.

When you erase a sequence from the memory recorder, the SPEED setting will be restored to 1.000. This is to reduce the chance of inadvertently recording a sequence at the wrong speed.

When you store a sequence on diskette, the current SPEED setting will be stored along with it.

LOOPS

In the introductory chapter, you used the LOOP button to establish an *overall*, *Da capo* loop on your sequence. An overall loop is one which affects every track in the memory recorder. A *Da capo* loop returns to the first note in the composition.

You may also place loops on independent tracks, creating *independent* loops, and establish *Dal segno* points, creating loops which return to an internal point in the sequence rather than to the first note.

In addition to those four options, you can establish a *justified* loop, which will keep the notes of the loop in perfect synchrony with the click track.

To summarize:

OVERALL simultaneous loop on all tracks

INDEPENDENT loop on an individual track

DA CAPO loop that returns to the first note

DAL SEGNO loop that returns to an internal point

JUSTIFIED loop where the notes are automatically synchronized with the click track

These loops can be used separately or in any combination.

The Cause of Glitches

Before discussing the various loops, we'd like to point out the simple solution to a common problem—the "glitch."

When you press LOOP in the middle of a note, that note will immediately begin its final decay. If the final decay is of any discernible length, you will hear a glitch each time the loop starts over, caused by the truncated final decay of the note at the end of the loop.

To create a clean loop, press LOOP immediately *after* the last note you want in your loop, but before the next note in the sequence.

Creating Overall *Da Capo* Loops

As you know, you create overall *Da capo* loops by pressing LOOP at the desired loop point.

Sequences with overall, *Da capo* loops can be stored on diskettes; when you recall them, the loop will still be there.

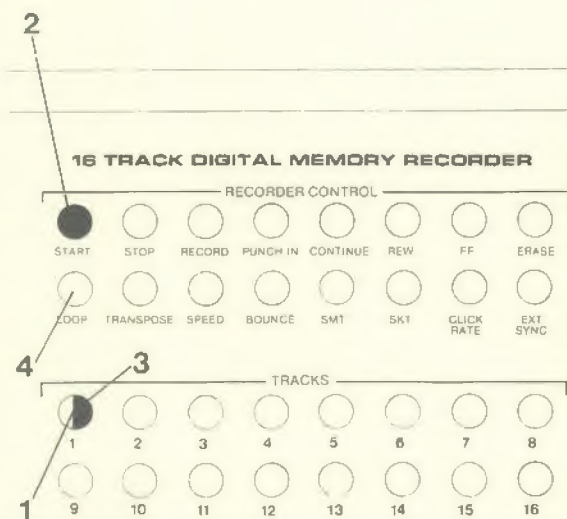
To remove a loop, simply press LOOP again (its light will go out).

Creating Independent *Da Capo* Loops

You can set up separate loops on individual tracks. One track can loop endlessly while the others proceed forward. Or, different tracks can have different length loops.

To create an independent loop, you *hold down* a track's button, and then you press the LOOP button when you want to start the loop.

When you store a sequence on a diskette, independent loops are stored also.



Try placing independent *Da capo* loops on "Scarborough Fair". (First remove the overall loop by pressing LOOP.)

1. Solo a track. Make sure its button is lit and no other.
2. Press START.
3. While holding down the track button,
4. Press LOOP at the desired loop point.

The LOOP light will go out when you take your finger off the track button. The track should now be independently looping between the first note on the track and the loop point.

NOTE: The second time you press a track button, you "unsolo" the track. Thus, you should be hearing the notes on all tracks while you hold down the track button and press LOOP. If this is disconcerting, press the track button twice quickly as you hold it down.

5. To verify that a track has an independent loop, press the track button again. While your finger remains on that button, the LOOP light will go on.
6. To remove an independent loop, hold down the button of the track that it's on and then press LOOP. The loop will disappear. (Check this by pressing the track button again. Now, the LOOP button will not light up.)
7. You can repeat this process for each track.

Creating Overall *Dal Segno* Loops

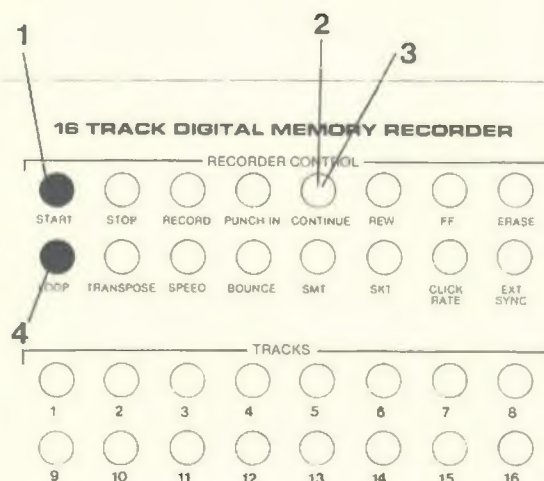
A *Dal segno* loop is any loop that returns to a point in the sequence other than the first note. There are two kinds of *Dal segno* loops: those that loop back to a precise instant in the sequence and those that loop back to a specific note.

To loop back to an precise instant in a sequence, press CONTINUE once to arm (or signal) the system to create a *Dal segno* loop and then a second time at the exact instant of the *Dal segno* point (point to which you want to return). Then press LOOP.

Recall "Scarborough Fair" again, remove the overall loop, and try this exercise.

1. Push START.
2. Press CONTINUE once to arm the system.
3. Press CONTINUE a second time at the *Dal segno* point.
4. Press LOOP at the desired loop point.

The recorder will loop internally between the point where you pushed CONTINUE the second time and the point where you pushed LOOP.

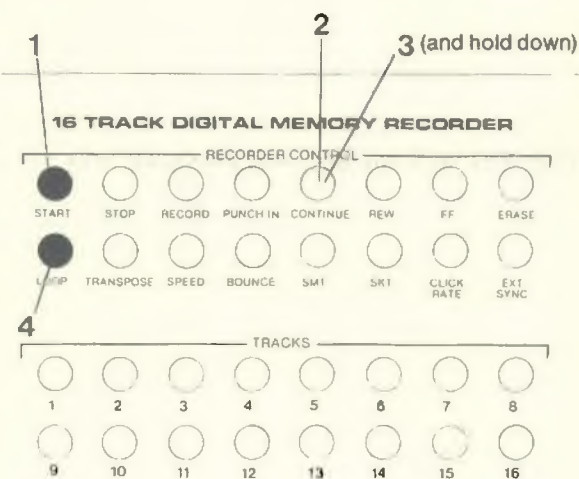


Since it is sometimes difficult to press CONTINUE at exactly the right instant, we have provided a way to align the *Dal segno* point with a specific note in the sequence.

The first note that sounds while you *hold down* CONTINUE will be the *Dal segno* note.

Recall "Scarborough Fair" again, remove the overall loop, and try this procedure.

1. Press START.
2. Press CONTINUE.
3. Then, before the note you wish to return to, press CONTINUE, hold it down until the note has sounded, and then release it.
4. Then press LOOP at the desired loop point. The loop will return to the first note that sounded while you held down CONTINUE.



Creating a *Dal Segno* Loop on an Independent Track

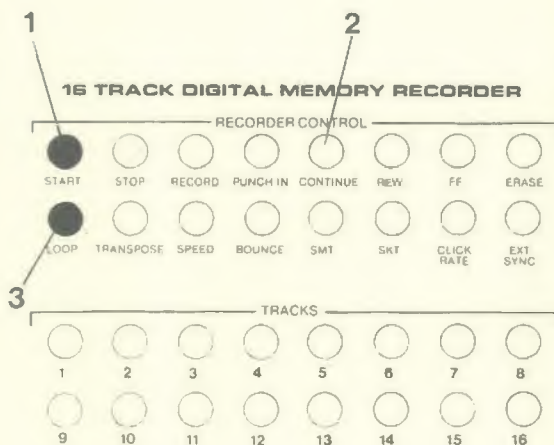
Before you begin, solo the track. Then establish either a *Dal segno* point or a *Dal segno* note, exactly as described above. Then, while holding down the track button, press LOOP at the desired loop point.

Dal segno points or notes on independent tracks are not removed when you press START and can be stored on diskette along with the sequence. In an overall *Dal segno* loop, however, the *Dal segno* point is removed when you press START. The sequence will continue looping but to the first note in the sequence. The only way you can store an overall *Dal segno* point on diskette is to establish independent *Dal segno* points at the same beat on all tracks.

Try creating some independent *Dal segno* loops on "Scarborough Fair."

Creating a Justified Loop

You can automatically synchronize the notes of any loop with the click track. We call this function the justified loop. The recorder waits until the loop length becomes an integral number of beats before initiating the loop. In this procedure, the CONTINUE button is used in still another way.



Recall "Scarborough Fair" again, remove the overall loop, and try the following exercise. It would be a helpful to have your click track audible. As stated earlier, the click rate for this sequence has been set at 120 beats per minute or 1 click per quarter note.

1. Press START.
2. Press CONTINUE once.
3. Then press LOOP just after the last note in the sequence you want to loop.

(NOTE: Any notes that are playing when you press LOOP will be cut off.)

The beginning of the loop will automatically sync in with the click rate. In other words, the beat of the digital metronome will remain steady.

Now remove this loop and try the following.

1. Solo track 1.
2. Press START.
3. Press CONTINUE once.
4. Then press button 1 under TRACKS and hold it down while you press LOOP just after beat 18.
The first note on the track will be played at beat 19.
5. In the same way, establish a justified independent loop on track 2 just after beat 30.
The first note on that track will be played at beat 31.
6. Now press buttons 1, 2, and 3 under TRACKS and press START to play the three tracks together.

Using the CONTINUE Button

As you may have noticed, the CONTINUE button is used in both *Dal segno* and justified loops. Pressing CONTINUE arms the system to perform either kind of loop. The function that is performed depends on the next button pressed.

Once the system is armed, if the CONTINUE button is the next button pressed, a *Dal segno* point will be established. If, however, the LOOP button is the next button pressed, a justified loop will be established.

If you want to create a *justified, Dal segno* loop, you must press CONTINUE three times: first, to arm the system, second, to establish the *Dal segno* point, and third to rearm the system. Finally, you would press LOOP.

Recording

You may also record into a loop, either overall or on an independent track.

TRANSPOSING

You've already learned how to perform overall transpositions with the TRANSPOSE button. To repeat, you simply press TRANSPOSE and then a key on the Synclavier® II keyboard. The transposition will be calculated on the basis of the interval between the key on the keyboard that you press and middle C.

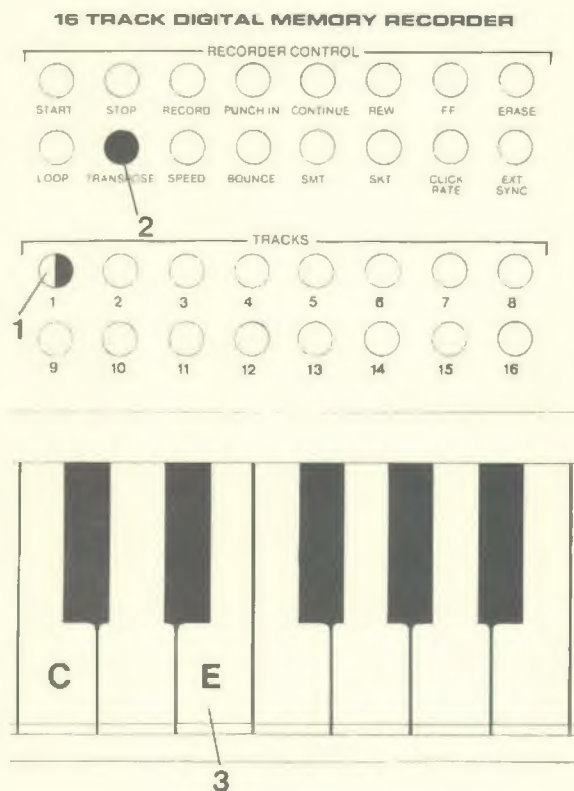
Thus, pressing E above middle C will transpose all notes a major third; pressing E flat above middle C will transpose a minor third; and pressing C above middle C will transpose a perfect octave, and so on.

You can instantly transpose during or before play back. You can store the sequence on diskette in the transposed key or return it to its original key by pressing middle C while the TRANSPOSE button is still lit.

To leave the TRANSPOSE mode, press TRANSPOSE again.

Independent Transpositions

You can also easily transpose independent tracks. All you have to do is solo the track first and then perform the transposition in the usual way. Such transpositions will remain in effect even after other track buttons are pressed. They can also be stored on diskette.



Recall "Scarborough Fair" again and try the following experiment.

Before you begin, use the BOUNCE button as described in the previous chapter to place a duplicate copy of the notes on track 1 on track 9 and a copy of the notes on track 2 on track 10. By doing so, you will be able to hear how the original and transposed notes sound together.

1. Solo track 1.
2. Press TRANSPOSE.
3. Transpose the notes on track 1 up an octave by pressing C above middle C on the keyboard.
4. To hear the original sequence and the transposed sequence play together, press button 9 under TRACKS and then press START.
5. Repeat this procedure with track 2; then play together with track 10.
6. Try playing all four tracks together.

If any track buttons are lit or blinking, each of those tracks will be transposed. If no track buttons are lit, they will all be transposed.

CHANGING TIMBRES WITH THE SMT AND SKT BUTTONS

In the introductory section, you learned to use the SMT (Select Memory Timbre) button to replace the timbres in a sequence with timbres from a bank. While you were learning how to use the SMT button, you may have noted that the SKT (Select Keyboard Timbre) button lights up at certain times.

The SKT button is a related button that allows you to take a timbre used in the memory recorder and make it active on the keyboard. Then you can change some part of that sound, such as volume or vibrato, and, using the SMT button, replace the timbre on the track with the modified sound.

You can also use the SMT button to replace the timbre on one track with the timbre on another.

In the following exercises, we will show you how to use the SKT button to change the volume of the timbre on track 1 of "Scarborough Fair". First listen carefully to the sound of track 1, both alone and along with the other tracks.

Activating a Recorder Timbre onto the Keyboard

1. Press SKT.

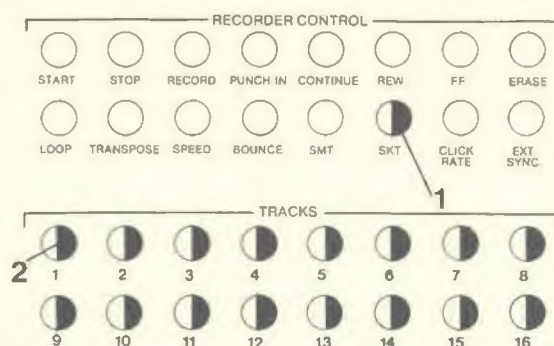
The SKT button will light up and the 16 TRACKS buttons will start blinking.

2. Press button 1 under TRACKS.

The SKT button and all the TRACKS buttons will go out.

3. Play a few notes on the keyboard. You are now playing the timbre that is on track 1.

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Changing the Sound of the Keyboard Timbre

At this point you could change anything about the sound that you wanted. (Learn about the options available in the section on "Designing New Timbres.")

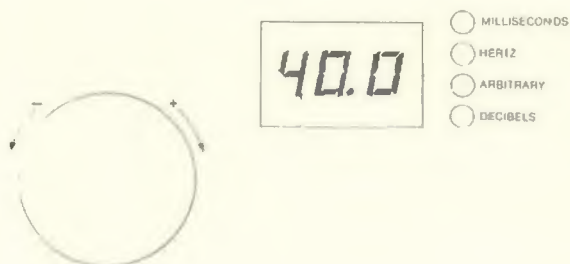
Try changing the volume of this timbre:

1. Make sure buttons 1 and 2 under PARTIAL TIMBRE SELECT are both lit. This timbre has two partial timbres.

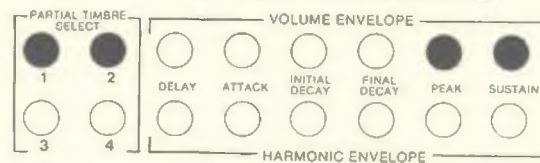
2. Press the PEAK and SUSTAIN buttons under VOLUME ENVELOPE simultaneously. (Make sure both buttons are lit.)

The number in the digital display window should be 60.0.

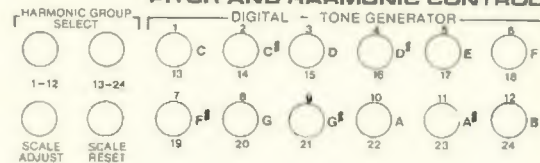
3. Turn the control knob to the left until the number in the window is 40.00.
4. Play a few notes on the keyboard. You will hear that the volume has been lowered by one third.



ENVELOPE GENERATORS



PITCH AND HARMONIC CONTROL



Placing the Keyboard Timbre onto a Track

Now that you have modified the timbre, substitute it on the track.

1. Press SMT.

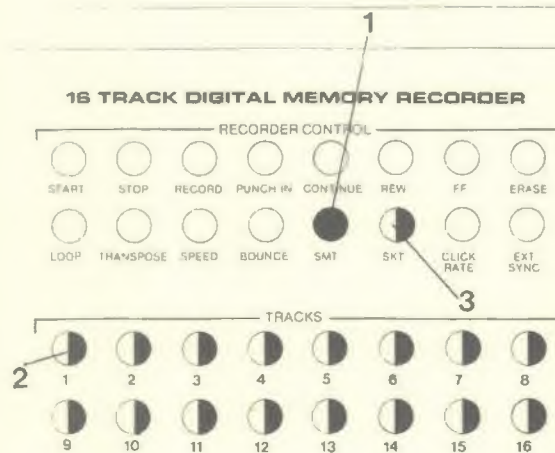
The SMT button will light up and the 16 TRACKS buttons will begin to blink.

2. Press button 1 under TRACKS.

The 16 TRACK buttons will continue to blink. The SKT button and the eight TIMBRE ENTRY buttons will start to blink.

3. Press SKT.

The SKT button, the TIMBRE ENTRY button, and the 16 TRACKS buttons will all go out.



4. Now press START.

You will immediately hear that track 1 is much softer in volume than it was.

When you used the SMT button in the introductory chapter, you pressed a TIMBRE ENTRY button to substitute a timbre from a timbre bank. In the exercise above, you pressed SKT to substitute the keyboard timbre. You can also substitute the timbre from another track. Press SMT, then the TRACKS button for the track on which you want to substitute a new timbre, and finally the TRACKS button for the track which has the desired timbre.

MORE ON RECALLING SEQUENCES

There are six numbered buttons under RECORDER STORE/RECALL. As mentioned in the introductory section, each diskette has room for a certain number of sequences of a certain maximum length. Many diskettes can hold just two sequences. Some have room for three, others for five or six. The size and number of spaces are clearly labeled on each diskette.

You cannot recall a sequence from a space that does not exist and you will run into an error message if you press the numbered button for a nonexistent sequence. For example, if you tried to recall sequence-3 from a diskette with only two sequences, Err4 would appear in the digital display window. Simply try another diskette or press button 1 or 2 under RECORDER STORE/RECALL.

There is one other error message you may run into when recalling sequences created on a system other than your own. Err5 may appear when the sequence you have recalled has been created in a system with a larger amount of memory than that in your system. Err5 indicates there are more notes in the sequence than in your memory recorder.

If you have dual disk drives, you can recall sequences from the diskette in the right-hand drive, by pressing DRIVE SELECT while you press the numbered button under RECORDER STORE/RECALL.

Err 4

Err 5

STORING SEQUENCES

You use the numbered sequence buttons to store sequences as well. First press the ENTRY WRITE button. While holding it down, press the RECORDER STORE/RECALL button for the sequence space in which you want to store the sequence. Your entire recording will immediately be written from the memory recorder onto the diskette.

Be sure to press the ENTRY WRITE button *before* the RECORDER STORE/RECALL button. Otherwise, you will recall an old sequence and lose your new sequence in the memory recorder.

This is what you will have stored (and what you will be able to recall instantly):

1. every setting for the timbre used on each track

This includes any real-time effects patching (covered in "Keyboard Control and Real Time Effects") and any programmed control voltage output (covered in "Studio Interfaces").

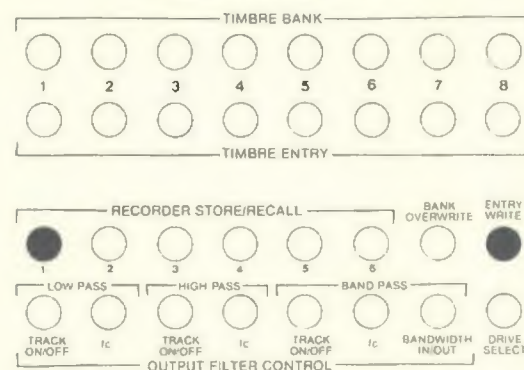
2. the notes on each track

If you have recorded on several tracks, they will remain unmixed. When you recall the recording, all the recorded material will remain on the same tracks that they were recorded on.

3. any overall or independent *Da capo* loops
4. any independent *Dal segno* loops
5. any overall or independent transpositions
6. the current click rate
7. the current speed setting
8. special scales

Establishing special, non-Western scales is covered in the section "Keyboard Control and Real-Time Effects."

TIMBRE STORE/RECALL



This is what you will *not* have stored:

1. the current tuning setting

When you recall your sequence, it will be played in the tuning that is active on the keyboard. This tuning can be changed at any time.

2. overall *Dal segno* points or notes

When you store a sequence, you will completely overwrite any sequence that was previously stored in that sequence space on the diskette. That sequence will be lost forever, so be careful to press the right numbered button. Valuable sequences should be protected by making a *duplicate* copy of the diskettes on which they are stored. (See "Formatting and Duplicating Diskettes" in the Appendix of this Guide or the separate "Utilities Manual" included in this binder.)

The Err4 error message will be displayed when you try to store a sequence on a sequence space that does not exist. Err6 will appear when you try to store a sequence which is too long to fit into the particular sequence space you have selected. Remember, different diskettes have sequence spaces of different maximum lengths. In either case, try another diskette.

In a dual drive system, you can store on the diskette in the right-hand drive by pressing three buttons simultaneously: DRIVE SELECT, then ENTRY WRITE, and a numbered button under RECORDER STORE/RECALL.

When you run out of storage space on your original diskettes, you can purchase blank diskettes from New England Digital. These will need to be formatted and duplicated before use.

III. DESIGNING NEW TIMBRES

In the introductory section, you learned to recall and play various preprogrammed timbres and to solo partial timbres.

Now you will learn how to program, modify, and combine partial timbres and create your own timbres.

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Modifying the Whole Timbre	83
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As you know, a Synclavier® II timbre consists of from one to four individual partial timbres which are added together to produce the complete sound. Each partial timbre is itself a complex sound with its own tuning, harmonic structure, frequency modulation, volume envelope, vibrato, and portamento.

It is helpful to think of the partial timbre as being constructed in levels of increasing timbral complexity.

The bottom level is the periodic waveform, which can be a simple sine wave or a complex waveform with up to 24 harmonic components.

Next, the periodic waveform may be frequency modulated. Very complex waveforms or even *nonperiodic* waveforms with *inharmonic* relationships between the overtones can be established.

We will refer to the frequency modulated periodic waveform as the steady state sound. In the next level of complexity, the steady state sound of the partial timbre is given a temporal shape. Both the volume and the depth of frequency modulation can be controlled by separate envelope generators. Thus, the loudness of a partial timbre can be made to vary throughout the duration of a note by the volume envelope (VE). Similarly, the depth of frequency modulation can be controlled by the harmonic envelope (HE) to create a note with time-varying overtones.

The steady state sound, modulated by the envelopes, forms the foundation of the partial timbre. It is programmed by using the buttons on the left panel and the control knob.

The foundation can be given many musical embellishments, such as vibratos of different rates, depths and wave shapes, and portamento. The embellishments are programmed by using the buttons on the third panel and the knob.

Finally, once a partial timbre is programmed, it can be combined with up to three other partial timbres to form a complete timbre. Each partial timbre within the same timbre can be individually tuned and can begin at a different time. Furthermore, the timbre as a whole can be modified in many ways. Literally endless varieties of complex sounds are possible.

In the next chapters, you will proceed level by level through the steps of timbre programming on Synclavier® II.


On Synclavier® II, there are two ways to change the overtone structure in a partial timbre: by adjusting the harmonic coefficients and by using frequency modulation.

We use *overtone* to mean a frequency component of a complex sound which is not necessarily harmonically related to the other components. Because, as noted below, the "overtones" produced by frequency modulation may have frequencies *below* the fundamental frequency of the waveform being modulated, our usage of the word varies slightly from convention.

HARMONIC COEFFICIENTS

Any *periodic* waveform can be synthesized by adding harmonically related sine waves of different amplitudes. This process is also known as Fourier additive synthesis.

By definition, the frequencies of the component sine waves of a harmonic series exist in fixed whole number relationships, that is, the fundamental, octave, fifth, fourth, etc. Thus, harmonic components cannot be individually tuned.

The amplitudes of up to 24 component sine waves may be individually controlled by adjusting the harmonic coefficients. The DIGITAL  TONE GENERATORS in the left panel are used for this purpose.

As sinusoidal components are "dialed in", Synclavier® II computes, by means of Fourier synthesis, the complex waveform and places it in a wavetable memory in the digital synthesizer.

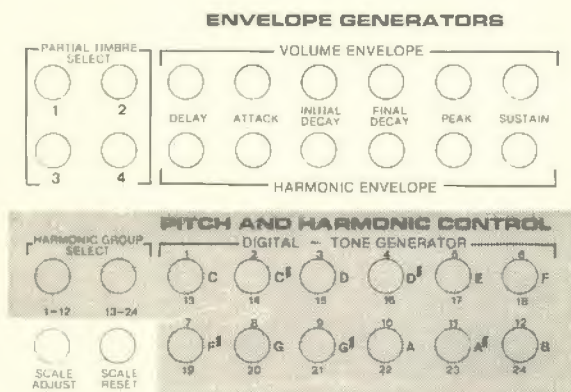
Note: Individual control over the phase relations of the harmonics is not provided in the Synclavier® II operating system. No musical advantage would result from this added complexity because of the ear's insensitivity to phase relations in periodic waveforms.

Although it is not necessary for understanding the following instructions, a textbook on musical acoustics may be helpful for the musician not already familiar with this subject.*

*A classic in this field is: John Backus, *The Acoustical Foundations of Music*, (W. F. Norton and Company, New York, 1969),

Adding Harmonics

You select a harmonic coefficient to modify by pressing one of the two buttons under **HARMONIC GROUP SELECT** and then one of the twelve buttons under **DIGITAL \sim TONE GENERATORS**. Then, you use the control knob to dial the relative volume of the selected harmonic. Turn the knob slowly, as this is a particularly fine adjustment.



Recall Timbre 1-1, which consists of a sine wave on partial timbre 1. Make sure button 1 under **PARTIAL TIMBRE SELECT** is lit.

1. Press the button labeled 1-12 under **HARMONIC GROUP SELECT**.

This causes the twelve buttons to the right to control the lower twelve harmonics. Button 1 will control the relative strength of the first harmonic (or fundamental frequency); button 2 will control the relative strength of the second harmonic (octave); button 3 will control the third harmonic, and so forth.

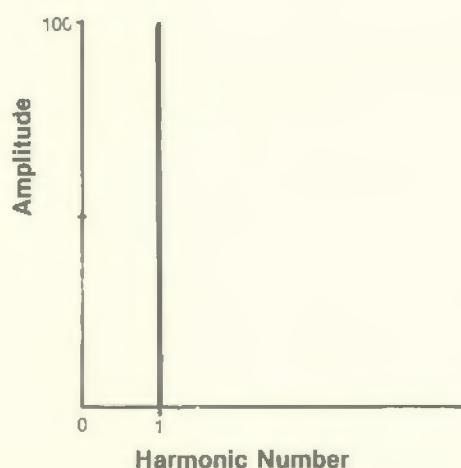
2. Press button 1 under **DIGITAL \sim TONE GENERATOR**.

The number 100.0 in the digital display window indicates the relative volume, or strength, of the fundamental frequency. The fundamental frequency of this sine wave will sound with 100 percent, or maximum, strength.

3. Press the other buttons 2 through 12, one at a time.

In each case, the number 0 will appear in the window. There are no other harmonics present in a sine wave!

A spectral display of this partial timbre is shown here. (The Timbre Display System provides real-time spectral displays of timbres.)



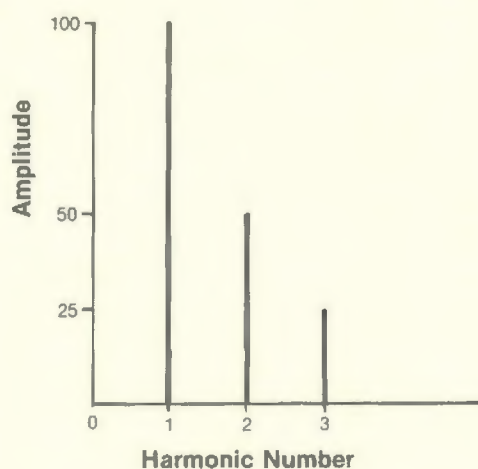
Spectrum of Sinewave

4. Press 2 again, and turn the control knob gently to the right until the number 50.0 appears in the window.

You have increased the relative strength of the second harmonic to 50 percent. If you press a key on the keyboard, you will hear a distinct second harmonic component in the sound.

5. Press 3 and adjust the strength of the third harmonic to 25 percent.

You have just created a complex wave shape. Its spectral display appears below.



Spectrum of Complex Wave

Experiment with different strengths in the harmonics. Sounds with a close approximation to sawtooth, triangle, and square waveforms can be dialed in. See "Dialing Specific Waveforms" in the Appendix.

A particularly interesting effect is achieved if you set the relative strength of the fundamental at 0 and the second and third harmonics at 100.0. Sounds created in this way have a "missing fundamental" and resemble certain categories of natural instruments. Timbre 4-7 on the Synclavier® II system diskette has a missing fundamental.

Another interesting effect is achieved by dialing a relative strength of .1 or .2 for the first harmonic and setting the others at 0. The sound produced at .1 is a perfect square wave and is a very good source for a clavinet.

Changing Harmonics in Groups

You can change the relative strengths of more than one harmonic at a time.

Try the following exercise.

1. Run your finger quickly over all the buttons except 1.

They will all light up.

2. Now dial 0.

Every harmonic except the first should now be set at 0.

This method can be used to change relative strengths of any group of harmonics quickly. Whenever more than one knob button is lit, all selected parameters will be changed with the control knob. If the numbers are the same for the various parameters, the changes will be the same. If they are different, the numbers will be locked together and will all be changed by the same amount. If any of the changing numbers reaches maximum or minimum value for the parameter, it will remain the same while the others will continue to change. In general, the number in the digital display window will indicate the setting for the rightmost lit control button.

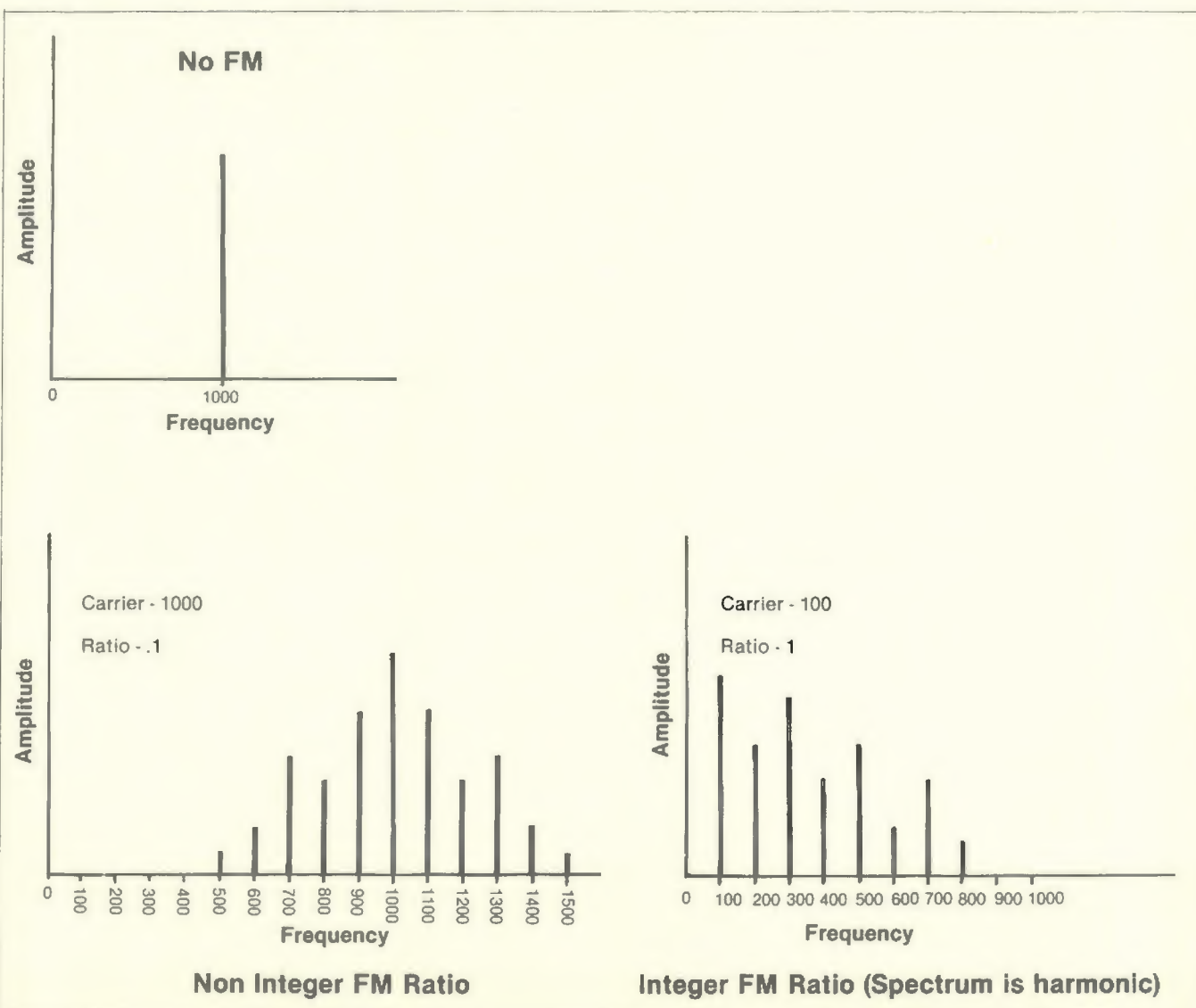
FREQUENCY MODULATION

The overtone content of a sound can also be increased through frequency modulation (FM), whereby the periodic waveform is phase-modulated by another sine wave. FM can be used to create very bright, brassy, percussive or resonant sounds, such as Timbres 1-2 (church bell), 2-5 (telephone), 4-8 (sweet bell), or 5-8 (violin).

Before proceeding with specific instructions, we include a brief theoretical explanation of frequency modulation.*

The effect of frequency modulation on a tone is to produce additional frequency components, or overtones. Whether these overtones are harmonically or inharmonically related to the original tone will depend on the ratio of their frequencies. If we plot the strength of overtones versus frequency in a spectral plot, overtones will be created on either side of the original, or *carrier*, frequency at intervals equal to the modulating frequency.

*For a more detailed discussion of this undeniably complex subject, see John Chowning, "The Synthesis of Complex Audio Spectra by Means of Frequency Modulation," *Journal of the Audio Engineering Society*, Vol. 21, No. 7, 1973, pp. 526-534. Reprinted in *Computer Music Journal*, Vol. 1, No. 2, 1977, pp. 46-54.



On Synclavier® II, the frequency of the modulating sine wave is determined by the *FM ratio*, which is the ratio of the modulating frequency to the carrier frequency. The actual frequencies, both of the carrier and of the modulator, will depend on the key pressed on the keyboard.

The FM ratio is set by pressing the F.M. RATIO button and turning the control knob. Dialing integer ratios will produce added harmonic content. Dialing non-integer ratios will produce inharmonic overtones. Thus, small changes in the FM ratio may produce dramatically different tone colors.

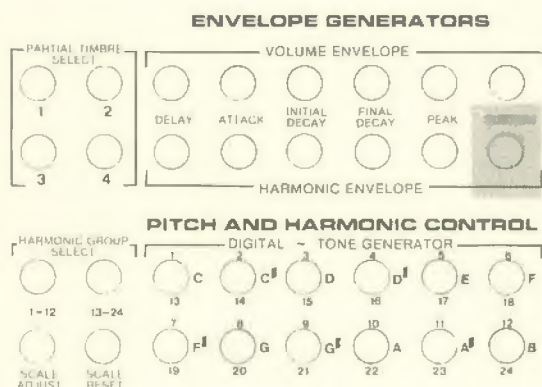
Fixed modulator frequencies (independent of carrier frequency) can also be established by dialing negative FM ratios.

The *relative strengths* of the overtones created by FM are determined by functions known in mathematics as first-order Bessel functions. Briefly, as the *depth of the modulation* increases, the strength of the original frequency decreases and the strengths of the overtones increase.

On Synclavier® II, the depth of FM is controlled by the harmonic envelope (HE). The HE generators can produce dynamic changes in the strength of FM generated overtones, which may be inharmonic as well as harmonic, depending on the setting of the FM ratio.

The higher the HE PEAK or SUSTAIN settings, the louder will be the FM overtones. If both HE PEAK and HE SUSTAIN are set at zero, there will be no depth of frequency modulation and no FM produced overtones. In this case, the FM ratio will be irrelevant. With nonzero settings in either HE PEAK or HE SUSTAIN, there will be FM.

Since depth of FM is controlled by the HE parameters, it can be made to vary during a note. To simplify matters, however, we will begin by frequency modulating a sustained tone. These exercises are designed to give you a conceptual base, rather than beautiful sounds. Programming musically interesting FM envelopes will be covered in the chapter "Programming Envelopes."



Increasing the Depth of Modulation

In this exercise, you will increase the depth of modulation on the periodic waveform (a sine wave) in partial timbre 1 in Timbre 1-1. You will use the SUSTAIN button located over HARMONIC ENVELOPE.

1. Press SUSTAIN.

The number 0 will appear in the window. There is no FM in the overall portion of this partial timbre.

2. While repeatedly striking a key on the keyboard, turn the control knob slowly to the right.

You will hear an immediate change as additional upper and lower harmonics become audible. The sound will become more and more brilliant. The range of settings is on an arbitrary scale from 0 (no FM) to 1000 (maximum FM).

Changing the FM Ratio

You will use the F.M. RATIO button located in the third panel of buttons in the second row under KEYBOARD INSTRUMENT CONTROL.

1. First set the harmonic envelope sustain level to around 60.

2. Press F.M. RATIO.

The number in the window will be 1.000. This is the ratio of the modulator frequency to the carrier frequency.

3. While holding down a key on the keyboard, turn the control knob slowly to the right. Stop when you reach 1.020.

You will hear a gradually increasing beating effect.

4. Continue to turn the knob, stopping to listen to the sound when you reach 1.050, 1.500, and 1.950.

The beats will turn into a distinct second, and increasingly higher, pitch added to the fundamental pitch. You will also hear some very *inharmonic* overtones.

5. Continue to turn the knob. Stop when you reach 2.00.

The beating effect will gradually slow down. At 2.00, the harmonics an octave above the fundamental will be accented.

6. Turn the knob back to 1.000.

7. Now press F.M. RATIO again.

The number in the digital display window will jump to 2.000 automatically.

The first time you pressed F.M. RATIO, you were activating the ratio function. Each additional time you press F.M. RATIO, you will step the ratio through the cycle of integer numbers from 1.000 to 16.00.

8. Step through the cycle while holding down a key.

A ratio of 4.000 will accent the harmonics two octaves above the fundamental, a ratio of 8.000 will accent the harmonics three octaves above, and a ratio of 16.00 will accent the harmonics four octaves above the fundamental.

The odd number ratios have different effects.

You can use the button to select an integer and the control knob to select a setting between that number and the next.

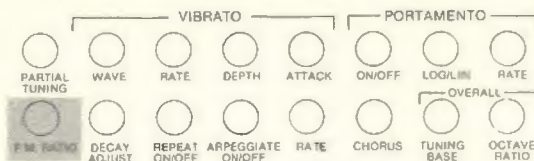
9. Try some very small ratios, such as .0000.

You will hear a "tremolo" effect. (Try changing the amplitude of this sound by varying the harmonic peak and sustain levels.)

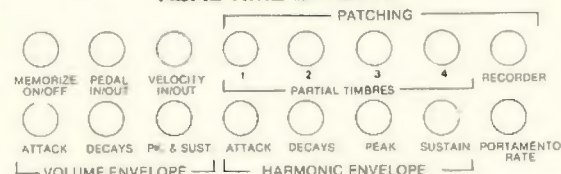
Negative settings from $-.1$ to -999 are used to specify a *constant* modulator frequency in hertz. The carrier frequency will depend on the key pressed on the keyboard, while the modulator frequency will remain at the setting established in the window.

10. After further experimentation, return the ratio to 1.000 and the harmonic sustain level to 0.

KEYBOARD INSTRUMENT CONTROL



REAL TIME EFFECTS



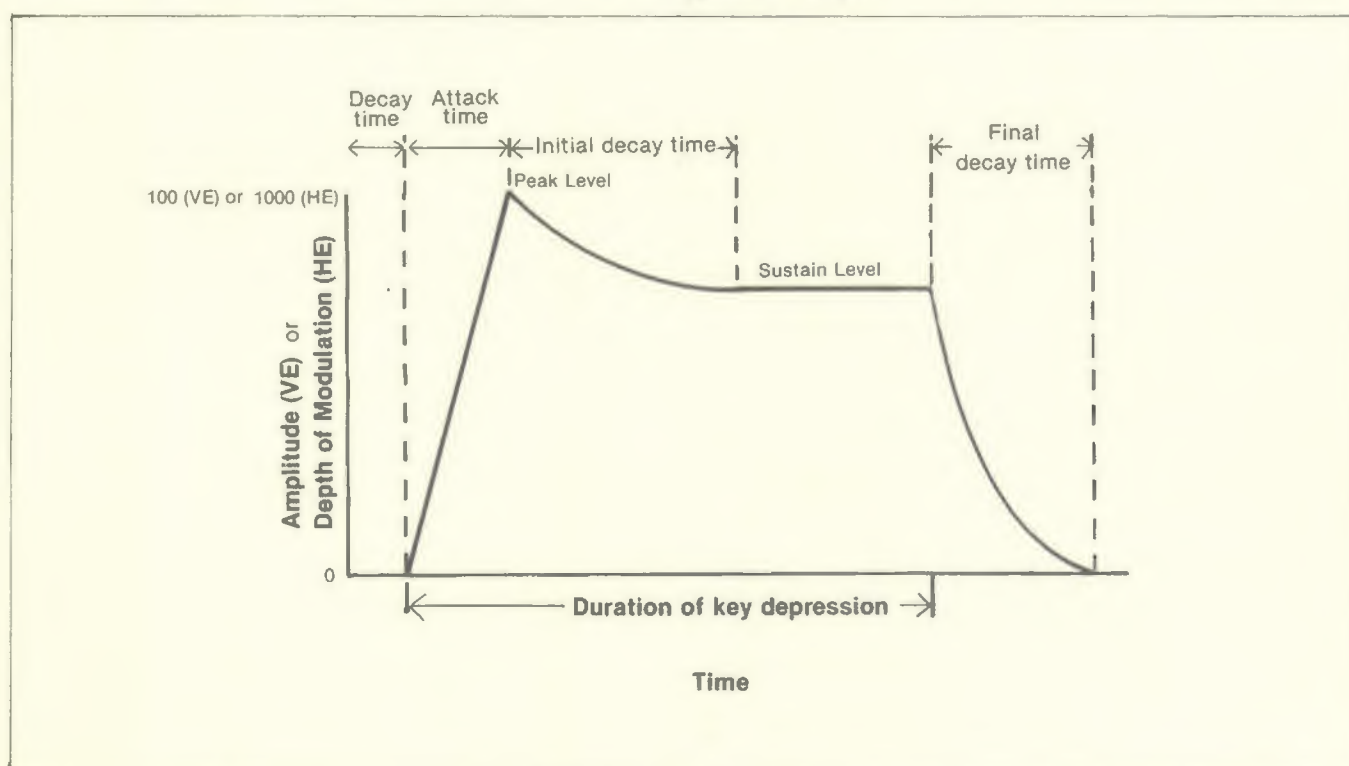
Using FM to create musically desirable sounds takes practice. There are many additional exercises in the next chapter.

PROGRAMMING TEMPORAL ENVELOPES

You use Synclavier® II's envelope generators to transform the steady state tone of a partial timbre into a life-like, dynamic sound. These parameters allow you to create separate temporal envelopes for both the amplitude and the overtone content of each partial timbre.

The volume envelope (VE) parameters allow you to divide the sound of a note into a series of time segments during which the volume level may rise or fall. The harmonic envelope (HE) parameters allow you to do exactly the same thing, except that the quality that is changing is the depth of frequency modulation.

The adjacent diagram illustrates the time segments and levels of a typical envelope.



All envelope programming is done with the twelve buttons located under ENVELOPE GENERATORS and the control knob. Just as with any parameter on Synclavier® II when you turn the knob, you will be able to hear the change instantly on the keyboard.

In addition, you can program a partial timbre so that you can vary its envelopes during performance with the pedal. This process is described in "Keyboard Control and Real-Time Effects".

THE VOLUME ENVELOPE

The volume envelope is used to give time-varying amplitudes, and a lively, natural quality, to the partial timbre. By programming different volume envelopes for a partial timbre, you can transform it into many extraordinarily different sounds. You can create sharp, muffled, or even delayed attacks, initial decays that go up or down in volume, and final decays of up to ten seconds or none at all.

You use the six buttons under VOLUME ENVELOPE and the control knob to program volume envelopes. The first four buttons, DELAY, ATTACK, INITIAL DECAY, and FINAL DECAY, are used to set time intervals. Each time interval can be set from 0 to 9999 milliseconds long. The last two buttons, PEAK and SUSTAIN, are used to set volume levels. Each level can be set from .0 for no sound to 100.0 for maximum loudness.

The volume envelope can be divided into three major time segments: the overall attack, the sustain, and the final decay.

The overall attack segment of the sound is the sum of three separate time intervals: the DELAY, the ATTACK, and the INITIAL DECAY. The DELAY setting is the time interval after you press the key and before the sound of the partial timbre begins. The ATTACK setting is the time interval during which the amplitude of the sound rises to the peak level. And the INITIAL DECAY setting is the time interval during which the amplitude falls, or rises, from the peak level to the sustain level.

The second time segment is the sustain time. This variable interval is the length of time you hold down the key *after* the overall attack segment. During this sustain *time* the note will sound with the sustain *level*, or steady state, amplitude.

To reach the sustain level amplitude, you must hold the key down longer than the overall attack segment. Often during fast passages, you won't reach sustain level.

The third time segment in the volume envelope is the FINAL DECAY. This is the interval after you lift your finger from the key during which the amplitude of the sound falls back to zero. Final decay will begin instantly when you lift your finger.

Variable Peak Level

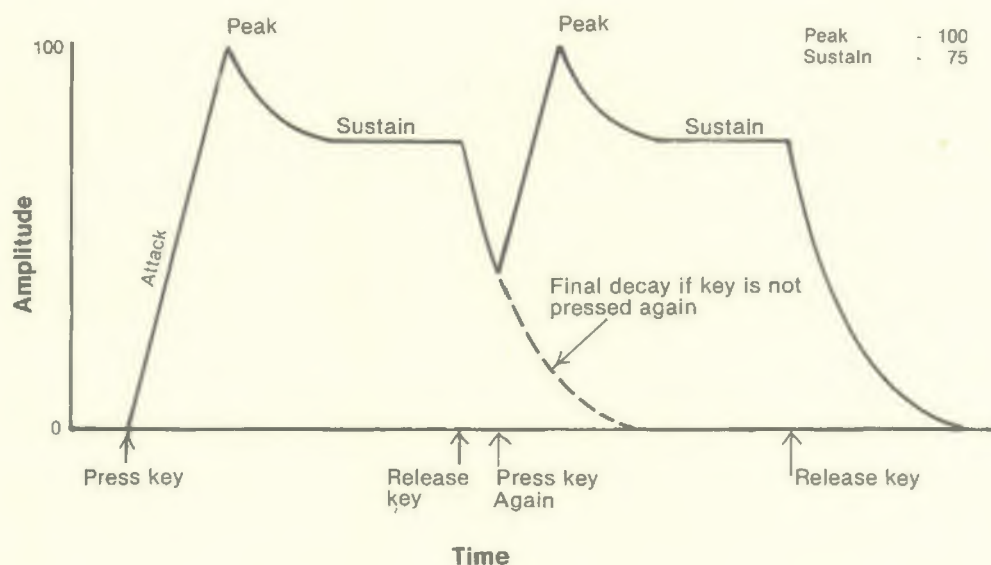
On analog envelope generators, peak voltage level (usually around +10 volts) is fixed. The amplitude of the sound will rise to peak voltage level at a rate determined by the attack time, and then fall to the sustain level at a rate determined by the initial decay time. You can create many different envelopes within this framework, but still, the peak level will always be the same.

On Synclavier® II, however, you can vary the peak level as well as the sustain level. You can set it above, equal to, or below the sustain level. You can even set the peak level at zero. This unique variable peak level, as well as the three separate attack time intervals, gives you tremendous control over the attack segment of the sound.

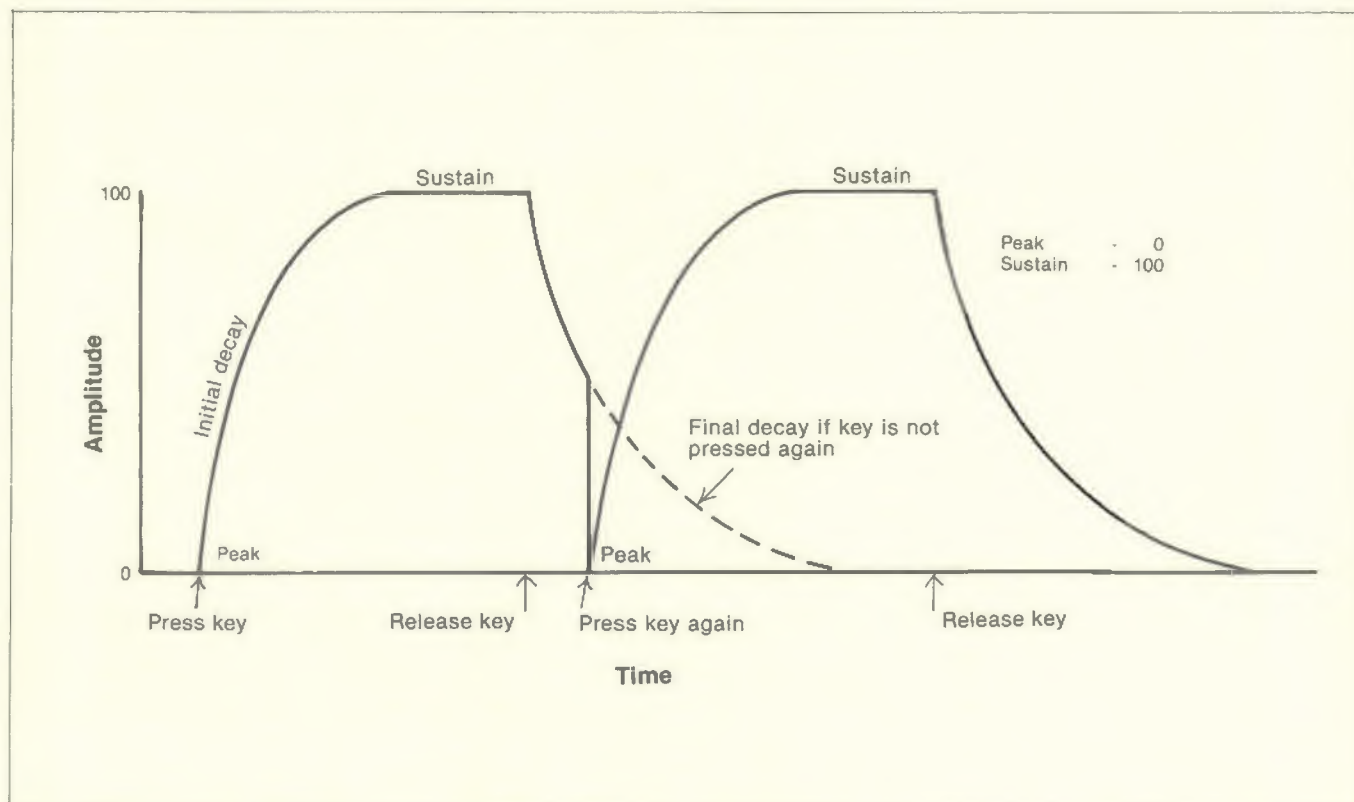
Normally the attack of a note will start at 0 amplitude. But if a preceding note of the same pitch and timbre is in final decay when you strike a key, the amplitude will rise, or fall, to the peak level from the current amplitude level.

Consider the following situations.

Imagine a partial timbre with a 100 percent VE peak level and 75 percent VE sustain level. If you press a key a second time before the first note has finished its final decay, then the attack of the second note will start at an amplitude somewhere between sustain level and 0, depending on exactly when you press the key. It will not begin at 0.



Now, if the VE peak level of the partial timbre is set at 0, an initial decrease in amplitude will occur if the key is pressed during the final decay of the first note. Timbre 7-1 has this sort of volume envelope.



The following exercises will get you started programming volume envelopes. In no way do they cover every possibility. Discovering your own unique sounds is part of the excitement of working with Synclavier® II.

Changing Overall Volume

Recall Timbre 1-3. It consists of a single active partial timbre. To make the exercises more interesting musically, we have chosen this timbre (with its added harmonics, vibrato, and 220.0 tuning base) rather than a sine wave.

You will use the control knob and the PEAK and SUSTAIN buttons located under VOLUME ENVELOPE in the first button panel.

Make sure button 1 under PARTIAL TIMBRE SELECT is lit.

1. Press VE PEAK.

The number 100.0 will appear in the digital display window and the small light labeled DECIBELS will light up. The number indicates the volume level of the *attack* segment of the sound.

(Note: The number is not based on the usual logarithmic decibel scale, but rather on a linear scale with 0 being no sound and 100.0 being maximum volume.)

2. Turn the knob to the left while striking a key.

You will hear no difference in the sound, because there is no extended attack time.

3. Return the VE peak setting to 100.0.

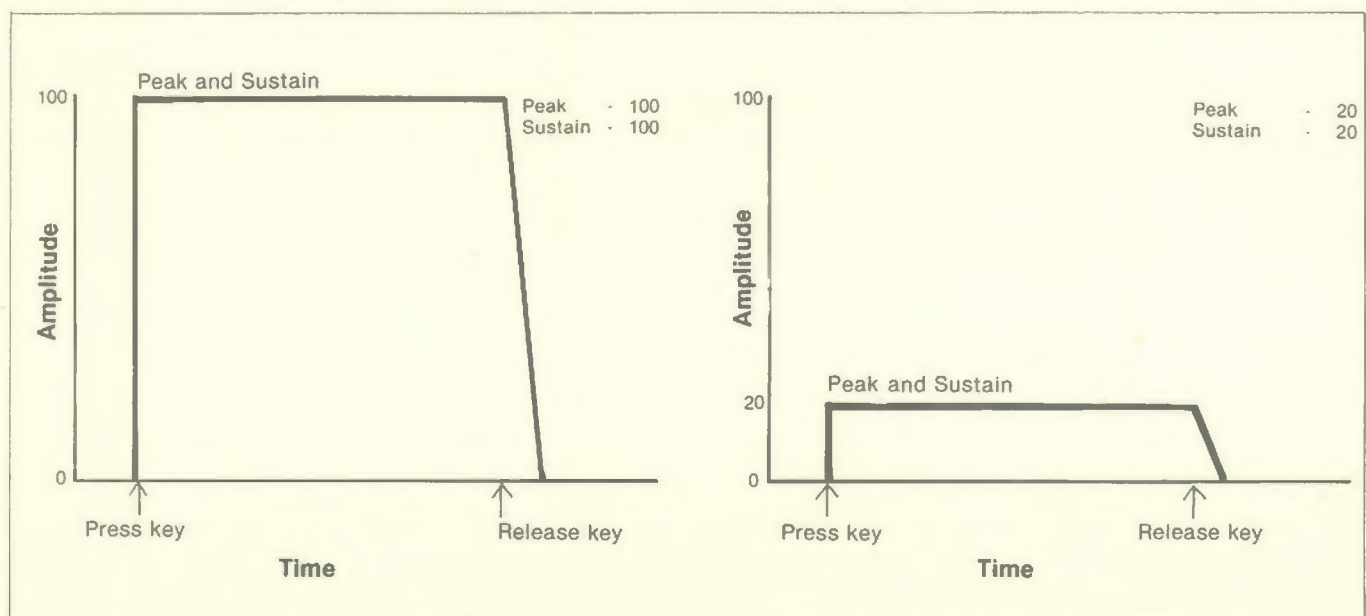
4. Press VE SUSTAIN.

The number 100.0 will remain in the digital display window, because the sustain level has also been set at 100.0. The sustain level is the *overall* volume level.

5. Now, while repeatedly striking a key, turn the control knob slowly to the left.

The overall volume will gradually decrease. But, since the peak setting remains at 100.0, you will continue to hear the very short attack, even when the sustain setting reaches 0.

Note: The time scale in the following envelope diagrams varies from diagram to diagram.



6. Return the VE sustain setting to 100.0.
7. Now press both VE PEAK and VE SUSTAIN simultaneously.
Both buttons will light up. When you turn the control knob, both peak and sustain levels will be changed.
8. Turn the control knob slowly to the left.
The attack volume level and the overall volume level will both change. When the setting in the window reaches 0, there will be no sound when you strike a key, and "bars" will appear in the window. The bars will always appear when you try to play a partial timbre with settings of zero for both volume peak and volume sustain.
9. Reset the VE peak and sustain levels at 100.0.

Adding a Delay

Delays will decrease the responsiveness of the keyboard, because there will be a delay between the time a key is pressed and when the note sounds. Coordinated delays can be used to control the onsets of different partial timbres in a complete timbre. Generally, at least one partial timbre in the timbre should have 0 delay for best keyboard performance.

In addition, as in Timbre 3-8, you can introduce a very short delay in the volume envelope and none in the harmonic envelope. Then FM will be in effect at the very beginning of audible sound. Note that there is no FM in Timbre 1-3.

Continue with Timbre 1-3.

1. Press VE DELAY.

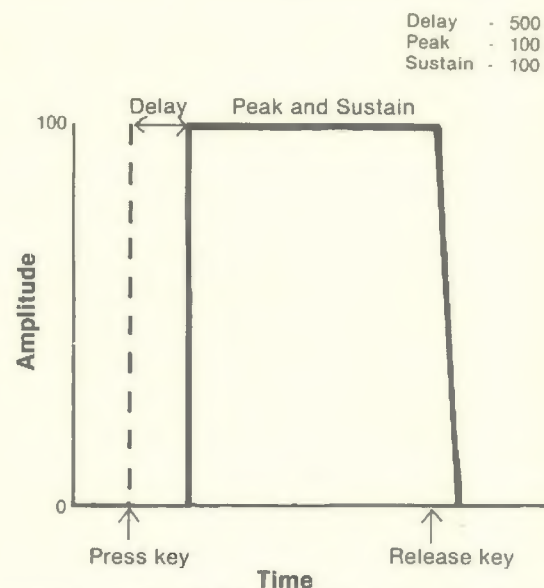
The DELAY button will light up. The number 0 will appear in the digital display window and the small light labeled MILLISECONDS * will light up.

There is no delay time. The partial timbre will sound as soon as you press a key.

2. While repeatedly striking a key, turn the control knob to the right.

The delays will get longer and longer.

You may dial any setting from 0 to 9999.



Lengthening the Attack

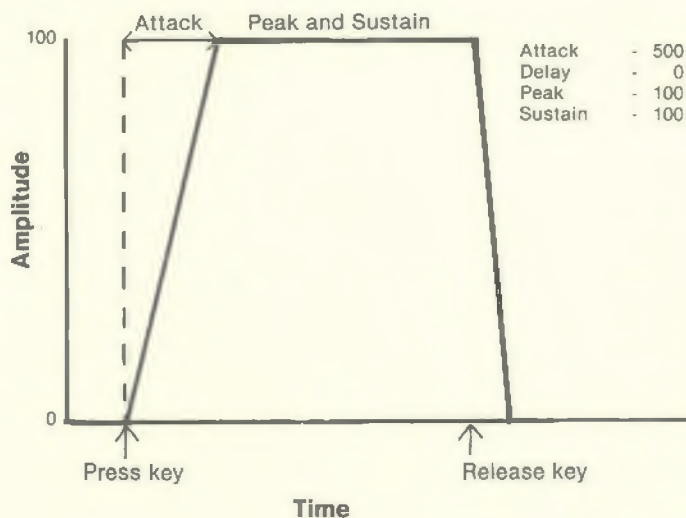
Recall Timbre 1-3 again.

1. Now press VE ATTACK.

The ATTACK button will light up and the number 0 will appear in the digital display window.

2. While striking a key repeatedly on the keyboard, turn the knob slowly to the right.

As the numbers in the digital display window increase, you will hear the attack time gradually lengthen. It is taking longer and longer for the amplitude to rise from 0 to 100.0.



An attack time of even a few milliseconds will make a perceptible change in the created sound. The maximum attack setting is 9999, essentially ten seconds.

Because the peak and sustain levels are the same (100 percent), you will find that the changes in initial decay settings make no difference to this partial timbre. Try it!

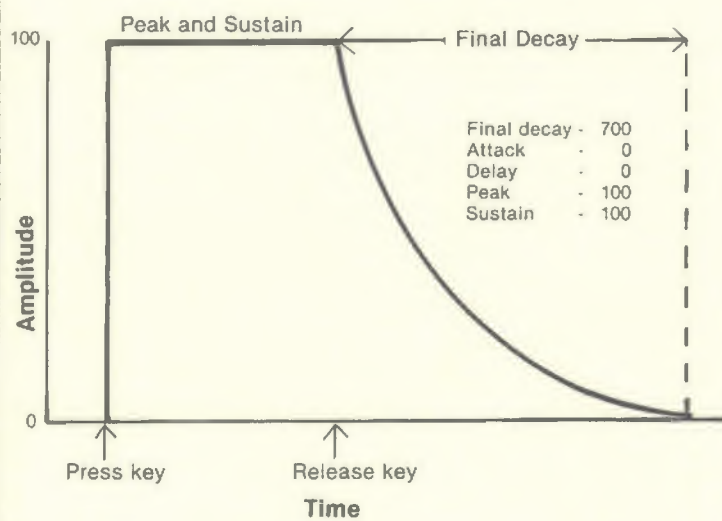
Adding a Final Decay

Continue with Timbre 1-3.

1. Press VE FINAL DECAY.

The number 150 will appear in the window.

2. Dial different settings.



Using a High Peak Level and a Low Sustain Level

Recall Timbre 1-3 again. This exercise is designed to demonstrate the interrelatedness of the different settings.

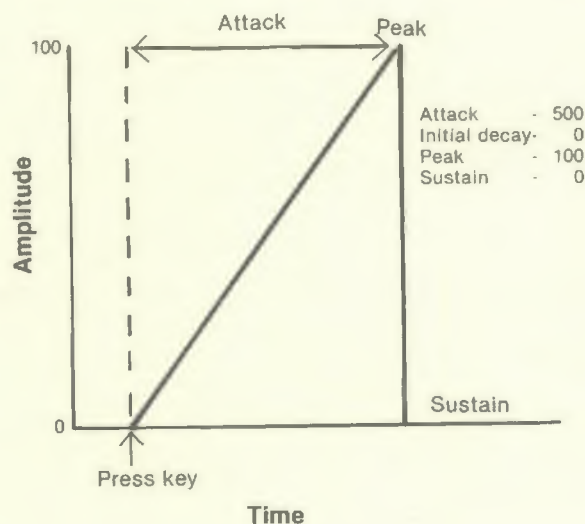
1. Dial a sustain level of .0, but leave the peak level at 100.0.

2. Set all the time settings to 0.

The sound of each note will be less than a click, but it will be audible.

3. Press VE ATTACK and turn the knob slowly to the right while striking a key.

The sound will get longer and longer. It will rise to peak level and then be cut off immediately.

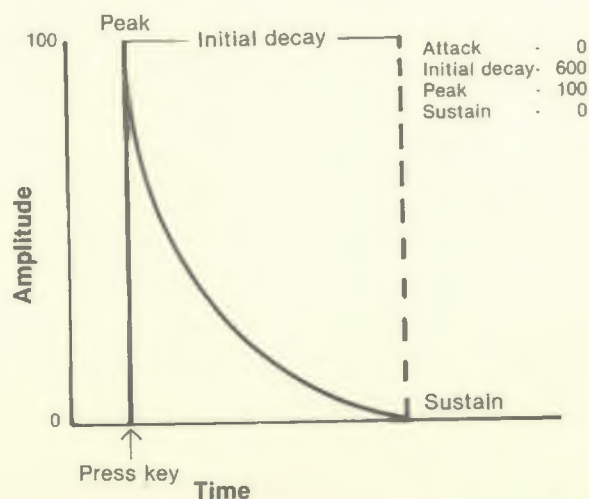


4. Return the attack setting to 0 before proceeding.

5. Now press VE INITIAL DECAY and turn the control knob slowly to the right as you tap a key.

The sound will get longer and longer. But now the amplitude is decaying from peak level to the zero sustain level. There will be a crisp attack.

This kind of volume envelope, with maximum peak and zero sustain, was used in programming the single partial timbre in Timbre 2-8.



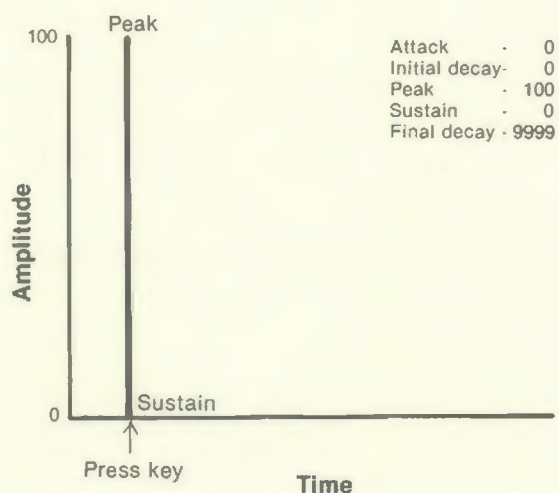
In this partial timbre, the initial decay has been set at 150. As you can see, it is an excellent framework for controlled percussive sounds.

6. Dial an initial decay setting of 9999 and hold down a key on the keyboard for at least ten seconds.

The sound will decay to zero while you hold down the key. During fast passages on the keyboard, there would be no difference in the sound of this partial timbre with its long initial decay and zero sustain settings and the sound of a partial timbre with a sustain setting of 100.0. With longer notes, however, the volume decay will be heard. And, you will never be able to hold a sound for more than ten seconds.

7. Return the initial decay setting to 0.
8. Now gradually increase the final decay setting to 9999.

Because there is no initial decay, the sound immediately falls from peak to sustain level. There is no sound left to go into final decay.

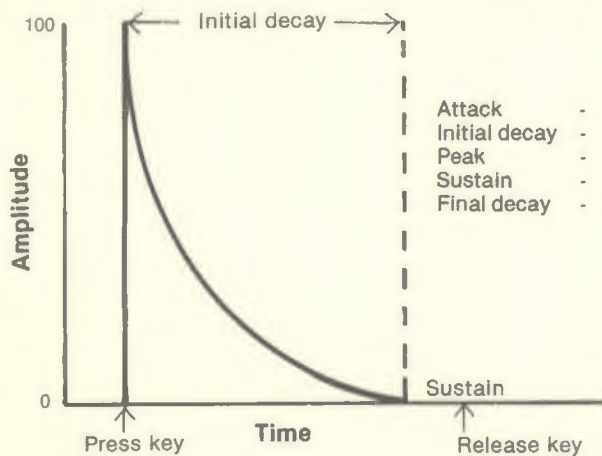


9. Leave the final decay at 9999, and set the initial decay at 350.

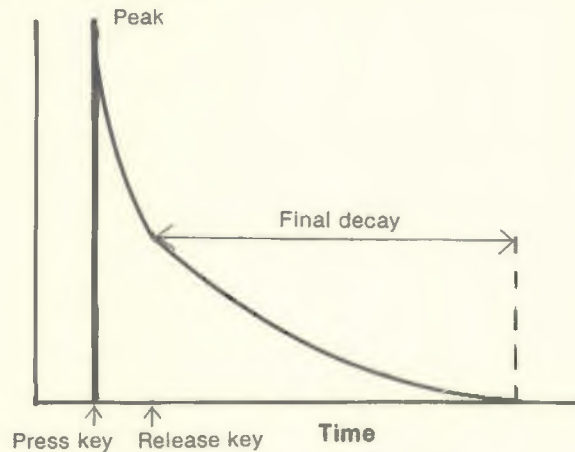
Now, if you release your finger from the key during the initial decay, the note will go into final decay. But, if you leave your finger on the key longer than the initial decay period, the note will be cut off.

This kind of envelope, with a short initial decay and a long final decay, has been used in Timbre 3-1.

Two Sounds from the Same Timbre

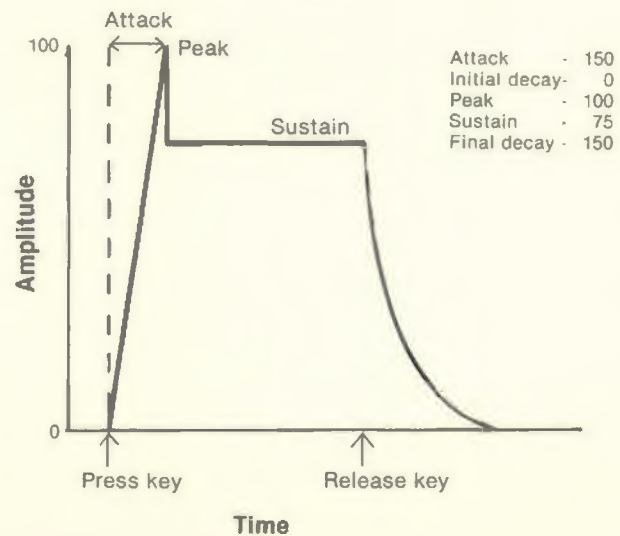


Releasing Key After Initial Decay



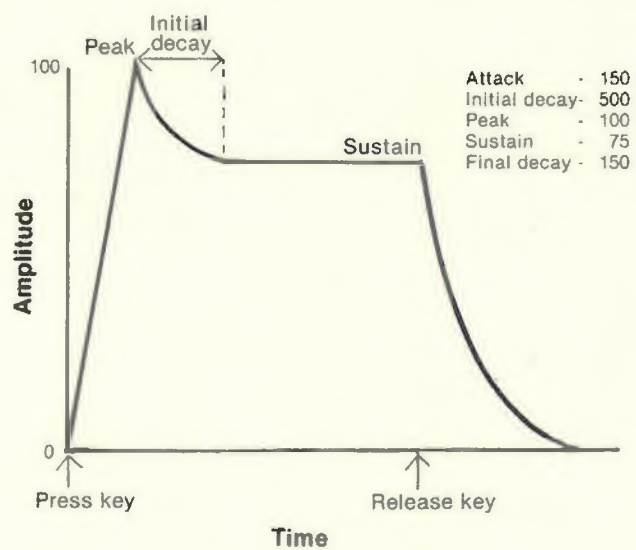
Releasing Key Before Initial Decay

10. Now change the sustain level to an above zero setting but still below peak. Set both attack and final decay at 150 and initial decay at 0. Now when you play a note, you will hear an abrupt change when the amplitude falls from peak to sustain level.



11. Press INITIAL DECAY and turn the control knob to the right slowly while striking a key.

The abrupt change in amplitude will gradually smooth out into a gentle decay.



Using a Low Peak Level and a High Sustain Level

Recall Timbre 1-3.

1. Set all the time intervals to zero and strike a note.

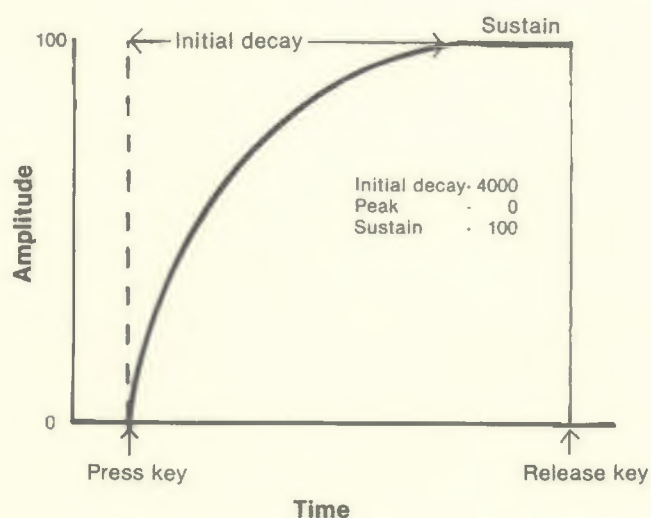
The sound will have a crisp attack.

2. Dial a peak level of .0, but leave the sustain level at 100.0.

The sound should be exactly the same.

3. Now press VE INITIAL DECAY and dial 4000.

Hold your finger on a key at least four seconds and you'll hear a sound with a long gradual attack. The amplitude is rising, instead of decaying, from a peak of .0 to a sustain level of 100.0.



4. Now press the ATTACK button again and try various settings.

You'll find that different attack settings have absolutely no effect on the sound. Because the peak level is set at zero.

5. Now set the peak level at 50.0.

6. Now try an attack setting of 200.

The amplitude will rise to 50 percent in about .2 seconds; then it will rise to 100 percent in about .1 seconds.

You can see that you could create extremely long and gradual initial rises in amplitude by using this method.

THE HARMONIC ENVELOPE

You have already explored the effect of the HE sustain parameter and the FM ratio in defining the steady state sound of a partial timbre. You will now learn to use the HE parameters to vary the depth of frequency modulation during the sound of a note.

The HE parameters are extremely powerful. For example, a partial timbre can start as a sine wave and transform into a complex waveform or into an inharmonic nonperiodic sound during a single note with the right programming of the harmonic envelope.

You use the six buttons over HARMONIC ENVELOPE and the control knob to program a particular harmonic envelope. Two of the buttons, PEAK and SUSTAIN, are used to set depth of frequency modulation. The PEAK button sets FM depth in the attack portion of the sound. The SUSTAIN button, with which you are familiar, sets FM depth during the overall sustain time of the sound. Both parameters can be set anywhere from 0 (no FM) to 1000 (maximum FM).

The other four buttons, DELAY, ATTACK, INITIAL DECAY, and FINAL DECAY, are used to set time intervals, just as in the volume envelope. Each time interval can be set from 0 to 9999 milliseconds long. Thus, the harmonic envelope is divided into the same three major time segments, the overall attack, sustain, and final decay, as the volume envelope.

You will find the initial decay parameter particularly useful in controlling the depth of FM. If a partial timbre has an HE peak level which is higher than the HE sustain level, you can use the initial decay setting to lengthen a bright attack. If a partial timbre has a low HE peak level and high HE sustain, the initial decay setting can be set so that maximum brightness is reached gradually.

In addition, the FM ratio will have an even more dramatic effect on a partial timbre with varying FM depth than it does on a steady state sound.

Remember, the harmonic envelope and the volume envelope of a partial timbre do not have to be the same. In fact, the sound will be particularly interesting if they are not.

We want to emphasize that it will take experimentation and practice to gain control over frequency modulation. Sometimes, partial timbres with high HE *sustain* levels can yield uncontrollable sounds that are musically useful over a very small range on the keyboard.

Synclavier® II is capable of producing the most incredible sounds you've ever heard from a synthesizer. But we do not deny that it is also capable of creating some of the worst noises you've ever heard from a synthesizer!

The choice is yours. Learn how to use FM well, and you'll be able to create musical sounds of great beauty.

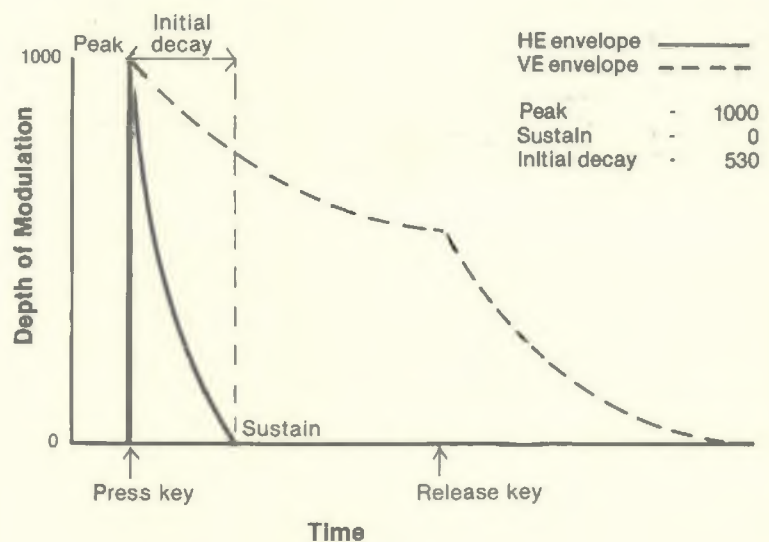
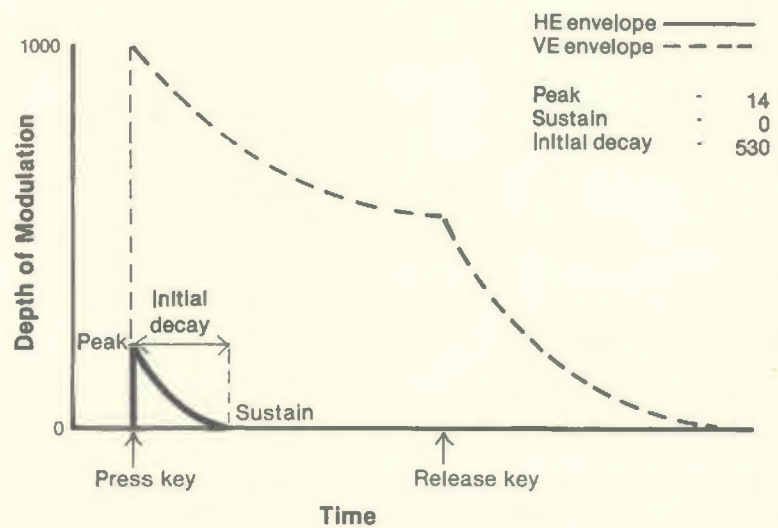
The following exercises will get you started.

Brightening the Attack

Recall Timbre 1-6. In the single partial timbre, the HE peak level is 14 and the HE sustain level is 0. The initial decay is 530. The FM ratio is 5.00.

1. Press HE PEAK.
2. While repeatedly striking a key, turn the control to the right.

You will notice the attack of the sound gets brighter and brighter. As you play each note, you will hear a distinct change at the end of the HE initial decay segment. FM level has reached 0 at that time.



A Brighter Attack

3. Experiment with different HE peak levels between 0 and 1000.

Broadening the Attack

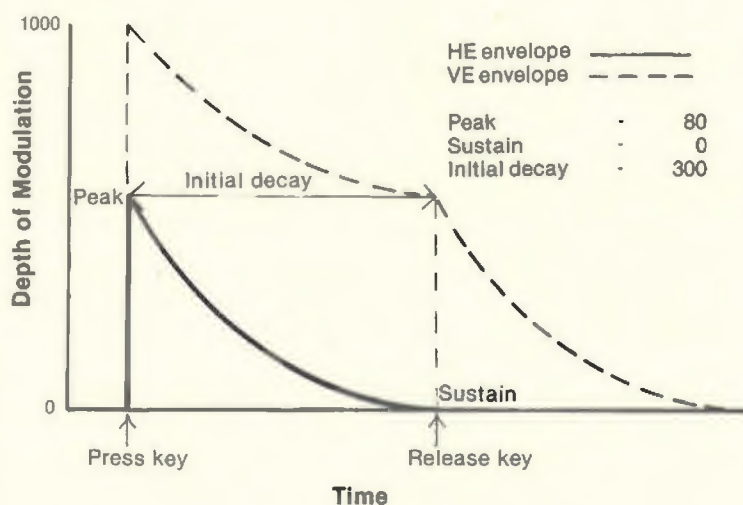
Recall Timbre 1-6 again.

1. Set the HE peak level at 80.
2. Press HE INITIAL DECAY.
3. While tapping a key on the keyboard, turn the control knob slowly to the left.

The attack will become a bright click.

4. Now turn the control knob slowly to the right.

The attack will get broader. At a setting of around 300, the bright click will have turned into a bright scraping sound. You are lengthening the time it takes for the FM level to fall from peak to zero.



A Broader Attack

Spend some varying just these two settings: the HE peak level and the HE initial decay time.

Extending the Brightness into the Final Decay

Recall Timbre 1-6 again.

1. Set the HE peak level at 128 and the HE initial decay time to 5000.

The brightness of the sound will last about five seconds. If you hold down a key longer than that, the FM will be cut off.

2. Now set the VE final decay to 5000.

Press a key and release it. You will hear a final decay that has no FM.

3. Set the HE final decay to above 5000.

Now, when you release the key, the brightness will ring out throughout the final decay. If you hold the key down longer than five seconds, however, the brightness will be cut off. And when you do remove your finger you will hear a final decay that has no FM.

Experiment with these four settings: HE peak level, HE initial decay, and VE and HE final decays.

Adding a Delay

Recall Timbre 1-6 again.

Introduce a delay in the harmonic envelope of 50 milliseconds and listen to the sound. The sound will begin as soon as you press a key; yet the frequency modulation will be delayed.

Now set a 50 millisecond delay in the volume envelope and none in the harmonic envelope. Listen to this effect.

Using Low Peak and High Sustain Levels

Recall Timbre 1-8. This partial timbre has 0 HE peak level and an HE sustain level of 30. The FM ratio is 4.000.

1. Change the attack of this sound by dialing different HE initial decay settings.
2. Combine different HE initial decay settings with different HE sustain levels.
3. Experiment with different HE and VE final decay settings.

FM Ratio

You have heard the effect of changing FM ratios on a steady state sound. Now try different FM ratios with a variety of HE envelopes. Or recall Timbre 1-2 or Timbre 2-1 and try changing the FM ratio.

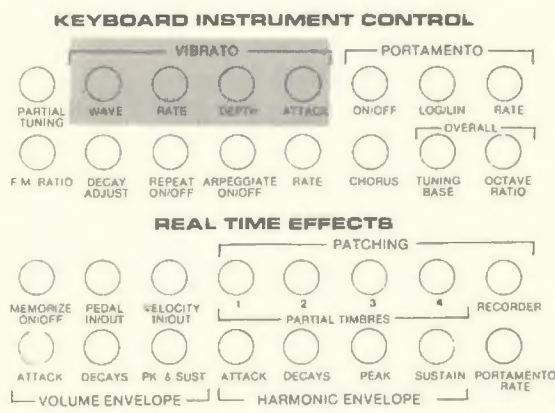
The steady state sound, modified by the volume and harmonic envelopes, forms the foundation of the sound of a partial timbre. But there are several other important ways to change the sound of the partial timbre.

In every case, you press the appropriate knob button and then turn the control knob to make the change.

VIBRATO

Each partial timbre can be given true vibrato, or periodic variation in pitch. There are several wave shapes available as well as a wide range of depths and rates. You learned how to vary rate and depth in the introductory section. Remember, both vibrato depth and vibrato rate must be above zero for vibrato to be audible.

You can also add a delay time for the vibrato.



Changing Vibrato Wave Shape

There are ten possible vibrato wave shapes. The first five are applied only to the carrier frequency. The second five are applied to both the carrier and modulator frequency. (Note: vibrato on the modulator will only be heard if there are above zero HE peak or sustain settings in the partial timbre.)

Each vibrato wave shape has a different symbolic number, as shown in the table below.

Vibrato Wave Shapes

Vibrato WAVE #	CARRIER	MODULATOR
1	Sine	None
2	Triangle	None
3	Sawtooth	None
4	Inverted Sawtooth	None
5	Square	None
6	Sine	Sine
7	Triangle	Triangle
8	Sawtooth	Sawtooth
9	Inverted Sawtooth	Inverted Sawtooth
10	Square	Square

There are two ways to select a different wave shape. In each case, you start by pressing the WAVE button. Then, you can either dial the number in the usual way with the control knob. Or, you can quickly step through the cycle of numbers, 1 through 10, by repeatedly pressing the WAVE button.

In the interest of clarity, the sound in this example is exaggerated, and not necessarily musical.

Recall Timbre 1-1.

1. Set the harmonic envelope sustain setting to 60.
2. Press RATE and dial a rate of 5.00 Hz.
3. Press DEPTH and dial a depth of 1 semitone.
4. Press WAVE.

The number in the window will be 1, indicating a sine wave vibrato, placed solely on the carrier frequency.

5. Now dial 6 and play the note again.

Sine wave vibrato is now placed on both carrier and modulator. The difference in sound between 1 and 6 should be clear.

6. Now step through the cycle to 2 and play a note.

This is triangle wave vibrato applied to the carrier alone.

7. Step through the cycle to 7 and play a note.

This is triangle wave vibrato applied to both the carrier and the modulator.

8. Compare in the same way wave shapes 3 and 8 (ramp); 4 and 9 (inverted ramp); and 5 and 10 (square).

Changing Vibrato Attack Time

A vibrato with a delay will build up gradually, rather than all at once. Thus, the vibrato will sound more natural, more like the vibrato of a traditional, nonelectronic instrument.

To add a delay, establish a vibrato in the usual way. Then press the ATTACK button and dial a delay of up to ten seconds (9999 in the digital display window).

ADDING PORTAMENTO

Synclavier® II's high frequency resolution permits smooth glitch-free portamento. You turn on the portamento effect by pressing the ON/OFF button under PORTAMENTO. When this button is lit, portamento is active on the partial timbre and glissandos will be produced between notes.

You control the rate of the change in pitch, and the duration of the glissandos, by pressing the RATE button and dialing a rate from the arbitrary scale of from .000 to 1.000. At a rate of .000, it will take almost a minute for a pitch to travel from one end of the keyboard to the other. Smaller changes in pitch will occur at the same rate. At a rate of 1.000, the change between one pitch and the next will be instantaneous.

The LOG/LIN Setting

The portamento rate can be linear or logarithmic. A linear portamento rate will change the pitch at the same rate throughout the entire glissando. A logarithmic portamento rate will accelerate the change in pitch.

When the LOG/LIN button is lit, the portamento rate will be logarithmic. When the LOG/LIN button is not lit, the rate will be linear.

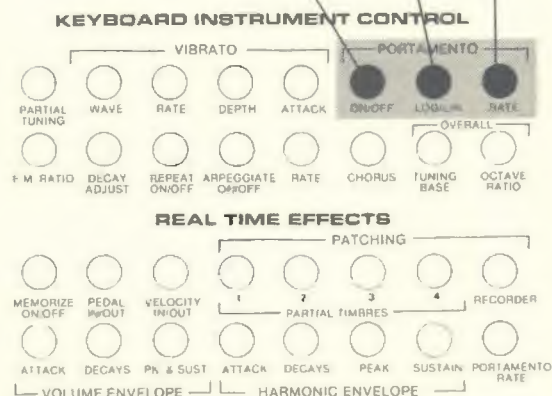
Try the following experiment. Recall Timbre 2-4.

1. Press ON/OFF under PORTAMENTO.
The button will light up and stay lit.
2. Play some notes on the keyboard.
Notice how the sound slides from note to note.
3. Press RATE.
The number .400 will appear in the digital display window. This is the portamento rate.
4. Slowly turn the knob to the left.
It will take longer and longer for the notes to slide from one to the next.
5. Dial a setting of 1.000.
The pitch will change instantly.
6. Dial a setting of .200 and play some notes.
7. Now press the LOG/LIN button and play some notes.
The slides will be accelerated.
8. Press ON/OFF.
The portamento function is turned off.

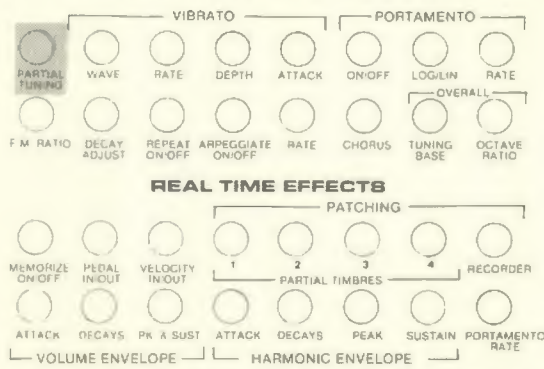
When lit - portamento on

When lit - logarithmic portamento

When lit - portamento rate can be changed



KEYBOARD INSTRUMENT CONTROL



TUNING

Each partial timbre can be individually tuned. To activate the partial tuning function, press the PARTIAL TUNING button and use the control knob to dial any tuning relative to A — 440.0 from 0.0 to 1760.0 in .1 Hz increments.

You can also use the PARTIAL TUNING button itself for quick octave changes in tuning. After you press the PARTIAL TUNING button the first time, each additional time you press it, you will step the tuning in octaves through the cycle

110.0 220.0 440.0 880.0 1760.0 Hz.

As you will see in the next chapter, partial timbre tuning becomes very important when the partial timbres are combined. Harmonic as well as inharmonic relationships between frequency components can be created in this way. Also, small tuning offsets can produce tremolo or amplitude modulation (AM) from the "beating" of the waveforms.

ADJUSTING THE FINAL DECAY

The decay adjust function allows you to program longer final decays for notes with lower pitches. This feature can be used to enhance the realistic quality of certain sounds.

Press the DECAY ADJUST button to activate the function and turn the control knob to change the decay adjustment factor from .000 to 1.000. A setting of .000 will cause all keys on the keyboard to trigger notes with the final decay programmed in the volume and harmonic envelopes.

The sound triggered by the rightmost key on the keyboard will always retain the original final decay. As you increase the setting, the final decays will gradually increase for all the other keys. A setting of .500 will double the length of the final decays every two octaves to the left of this key. A setting of 1.000, the maximum, will double the length of the final decays every octave.

Recall Timbre 2-6 and try different decay adjust factors.

1. Press DECAY ADJUST.

The number in the digital display window will be .000. All notes, no matter what key you press, will be played with the final decays established in the volume and harmonic envelopes.

2. Dial .500.

When you press keys on the keyboard from right to left, the final decays of the notes will gradually lengthen. Every two octaves down, the length of the final decays will have doubled.

3. Dial 1.000.

Now, when you press keys on the keyboard from right to left, the length of the final decays will have doubled every octave.

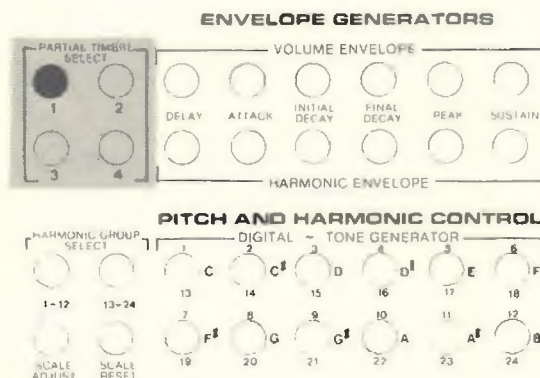
So far, in this section, you have received instructions on programming the single partial timbre. The timbres you have recalled and modified have all had only one active partial timbre. To be active, a partial timbre must have above zero peak or sustain levels in its volume envelope. A partial timbre with .1 peak or sustain volume level, is active, even though inaudible, and the computer will assign it a voice in the synthesizer. (Using such a partial timbre would obviously waste a voice.)

But timbres need not be limited to a single sound. Up to four active partial timbres can be combined. This enables you to mix sounds with different waveshapes, different volume and harmonic envelopes, different tunings, different portamento rates, and different vibratos.

For a rich sound, each partial timbre in a timbre can be tuned slightly higher or lower than the others. Or two partial timbres can be tuned to produce beats, or amplifications of the sound at regular intervals. Note that the number of beats per second equals the difference in frequency of the two partial timbres.

Partial timbres can also be tuned in harmonic relationships, with partial timbre 1 at 440, partial timbre 2 at 880, partial timbre 3 at 1320, and partial timbre 4 at 1760. Then, to make a sound with dynamically varying harmonic content, each partial timbre can be given its own envelope.

You learned to solo and select partial timbres for programming in the Section I.



Try the following exercises.

Recall Timbre 5-4. This timbre has four identical partial timbres. They tend to dampen each other's sound. To enrich the sound, give each partial timbre a different tuning.

Start with button 1 under PARTIAL TIMBRE SELECT lit.

Changing the Tuning of One Partial Timbre While Listening to the Others

1. Now press the PARTIAL TUNING button. The number in the window will reflect the tuning of partial timbre 1.
2. Now, while tapping a key, turn the knob.
You will change the tuning of partial timbre 1 while listening to the other three partial timbres.
3. Try tuning the other partial timbres in the same way.

Programming a Soloed Partial Timbre

1. Now press button 1 under PARTIAL TIMBRE SELECT twice (make it blink) to solo partial timbre 1.
2. Press VE DELAY and dial in a distinct delay.
While you make the change, you will be able to hear just the one partial timbre.
3. To listen to the complete timbre after you make the change, press button 1 again.
Partial timbre 1 should start after the other three partial timbres.

There are additional controls that you can apply to the timbre as a whole, whether it has one, two, three or four active partial timbres.

CHORUS

The chorus function is used to reproduce, with different tuning, all the active partial timbres on additional synthesizers. You can create a doubling effect, with the sound of several similar instruments playing the same note with slightly different tunings, such as a group of first violins. Or, you can create several instruments playing in two-part harmony. Or you can dial completely inharmonic cacophony.

A chorus effect can be created with any desired harmonic, or inharmonic, interval between the voices. Very rich sounds and up to eight voices in one timbre can be established quickly.

When you use the chorus effect, you double the number of voices required to play the timbre. A one partial timbre with chorus will require two voices. A two partial timbre with chorus will require four voices, and so on.

You press the CHORUS button to activate the chorus function. Then you turn the control knob to set the chorus ratio, or interval.

Recall Timbre 2-6.

1. Press the CHORUS button and experiment with settings between .990 and 1.009.

The doubled sound will be very rich, but basically in unison.

2. Dial 1.250.

Now every note you play will be chorused by a voice a major third above.

3. Dial .500.

Each note will be chorused by a voice an octave below.

4. Dial 2.000.

You have added a chorus effect an octave above the fundamental.

5. Experiment with settings from 1.990 to 2.009.

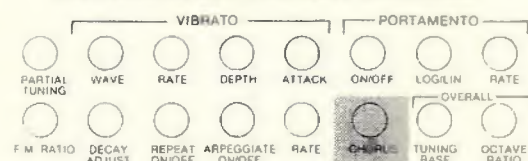
You can dial any ratio from .000 to 10.00.

If you press the CHORUS button again, you will return the setting to 1.000, or unison.

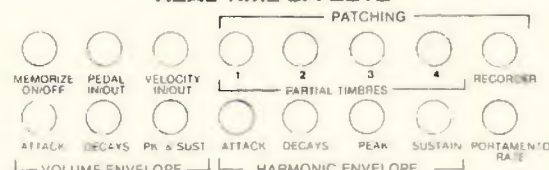
The table below shows you how to dial the most common intervals.

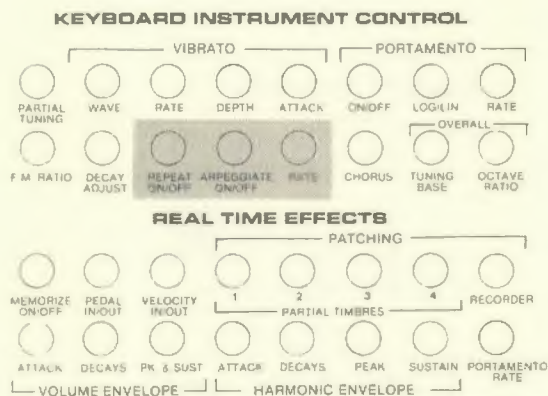
10.00	Three octaves plus a major third
9.000	Three octaves plus a second (two octaves plus a ninth)
8.000	Three octaves
7.000	Two octaves plus a flat seventh
6.000	Two octaves plus a fifth
5.000	Two octaves plus a major third
4.000	Two octaves
3.000	Octave plus a fifth
2.000	Octave
1.500	Perfect fifth
1.250	Major third
1.000	Unison
.500	Octave below
.250	Two octaves below
.125	Three octaves below

KEYBOARD INSTRUMENT CONTROL



REAL TIME EFFECTS





ARPEGGIATE and REPEAT

The repeat and arpeggiate functions cause multiple notes to be triggered by each pressing of a key. With the repeat function alone, the same note or chord will be repeated at the established rate, over and over until you take your finger off the key or keys. With the arpeggiate function alone, pressing two or more keys will cause the notes to sound one after another at the established rate. Combining the two functions creates repeating arpeggios.

To turn on the repeat function, just press REPEAT. It is an on/off button. Then, press the RATE button and dial the desired rate, from .00 to 100.0 Hz. To turn on the arpeggiate function, just press ARPEGGIATE. It is also an on/off button. The same rate button is used for both functions. If you have both REPEAT and ARPEGGIATE buttons lit, the notes of the arpeggio will be played at the rate established and then repeated as long as you hold down the keys.

Recall Timbre 3-1. The REPEAT button will be lit.

1. Press the RATE button and experiment with different rates while holding down a key.

You will notice that as soon as you lift your finger the repeat will stop and the note will go into final decay.

2. Now press VE ATTACK and lengthen the attack.

You will note that the repeats become blurred. To keep a clean attack, the length of each attack must be shorter than the length of each repeat. Of course, you may want to make use of this special blurred effect.

3. Return the attack setting to 0 and set the repeat rate at around 5.00.

4. Gradually increase the VE sustain level.

The sustain amplitude will eventually overpower the repeating attack sound.

5. Now gradually turn the HE sustain level down to zero.

You will hear a strong attack over the sustain sound.

6. Turn off the repeat function by pressing REPEAT.

7. Press ARPEGGIATE.

Press several keys and hold them down. The notes will arpeggiate at the established rate.

Try hitting a large chord with both hands all at once. No matter how fast you press the keys, the notes will always arpeggiate at the set rate. The notes will be played in the order that you press the keys. The computer can always pick this out, even if you can't.

8. Now press REPEAT again.

The notes will continue arpeggiating at the set rate as long as you hold down the keys. As you press more keys, those notes will be added to the arpeggio. If you lift your finger from a key, that note will be subtracted.

Note that repeats and arpeggios can be recorded in the memory recorder just as they sound in real time.

KEYBOARD POLYPHONY CONTROL

You can limit the number of notes that can be played at the same time on the keyboard or on a specific memory recorder track. We call this function the keyboard polyphony control.

Most of the timbres on the system diskette are programmed to be fully polyphonic on the keyboard. With these timbres, you can simultaneously play notes until you use up all the voices, or synthesizer channels, in your system. Thus, the maximum keyboard polyphony depends on both the number of voices in your system and the voices used in the keyboard timbre.

If a key is pressed and there are not enough unused voices to play the note, the system will try to play it by checking for and then cutting off any notes in final decay. If enough voices cannot be freed up in this way, the new note will not play. "Bars" will appear in the digital display window to warn you that you are out of voices. You should already be acquainted with all this information.

You can choose less than maximum keyboard polyphony for a timbre. By dialing a polyphony number of one, for example, you make the timbre monophonic ("lead synthesizer") on the keyboard. In a monophonic timbre all overlapping final decays will be cut off. You will be able to play clean trills or other fast sequences, even if the timbre has a long final decay. But you will not be able to play a chord.

To activate the polyphony control, you make all four PARTIAL TIMBRE SELECT buttons blink by pushing one button twice and holding it down while you push the other three buttons. The timbre's keyboard polyphony will be displayed in the digital display window. You then dial the number of desired simultaneous notes with the knob.

To hear how this polyphony control works, try the following experiment:

Recall Timbre 6-6. This timbre has a long final decay.

1. Push any PARTIAL TIMBRE SELECT button twice and hold it down while you push the other three buttons. Alternately, slide your thumb quickly over all four buttons (This may take a few tries to get the feel of it.)

The polyphony number which appears in the digital display window should equal the number of voices in your system.

2. Play a scale.

The final decays will overlap the notes that follow.

3. Now turn the dial to the left until the number in the window is 1.

You are making the timbre monophonic on the keyboard.

4. Play another scale.

Only one key will sound at a time. Each succeeding note cuts off the decay of the one before. Only the last note played will have full final decay.

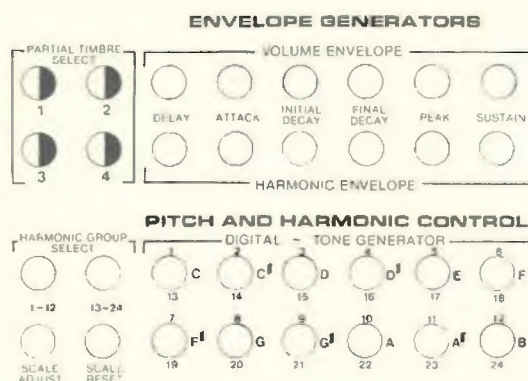
5. Hold down a key while striking another.

The second will not sound until you release the first.

6. Now dial 2 and experiment with scales and arpeggios.

At any one time only two voices will be heard. When you play the third note in a sequence, it will cut off the first.

7. Experiment with settings of 3 and 4.



In the introductory section, you recalled and played several specific timbres from the system diskette. Now let's examine the programming that created those sounds.

The following figures have been taken from the Timbre Display System. If you have the TDS option, you may want to use it at this time.

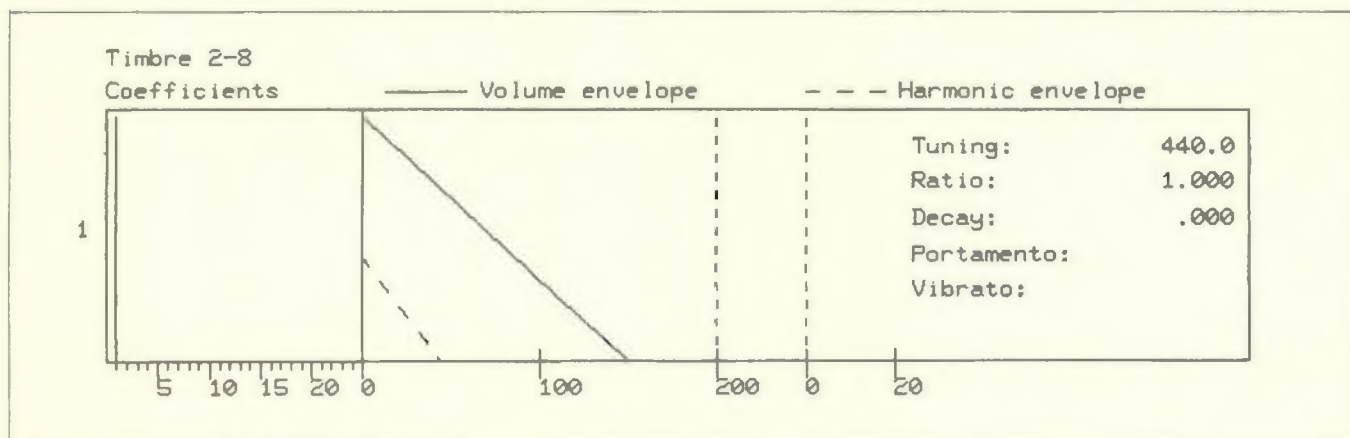
Timbre 2-8

Only one partial timbre is used in Timbre 2-8.

The left-hand window is a spectral display of the relative strengths of the harmonic coefficients in the partial timbre. One sine wave, the fundamental, is given 100.0 percent strength in this partial timbre.

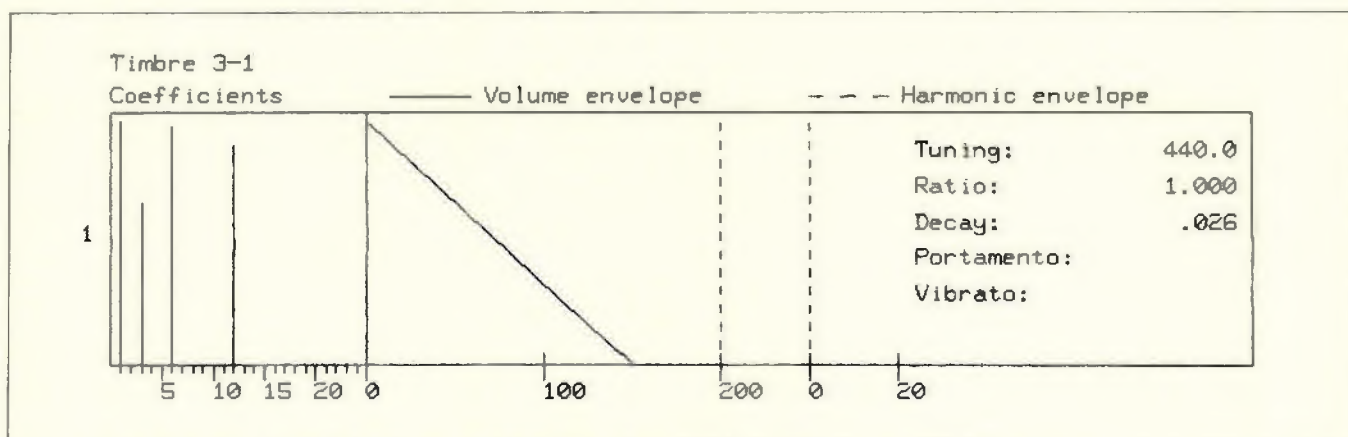
In the right-hand window are plotted the volume and harmonic envelopes. Since the VE attack and delay times are zero, the sound will hit peak volume as soon as you strike a key. Then it will decay to sustain level, which is zero, in a very short period of time. The final decay period is so short as to be inaudible. The harmonic envelope final decay period is longer than the volume envelope final decay. Thus, the FM-produced overtones will still be strong when the sound zeroes out.

In the right-hand window you will also see that the tuning for partial timbre 1 is 440.0, the (FM) Ratio is 1.00, there is minimal decay adjust factor, and no portamento or vibrato.



Timbre 3-1

This timbre has four sine waves. In both volume and harmonic envelopes there is zero delay and attack times and zero sustain level. If you lift your finger from the key during initial decay, you will hear the long final decay. If you allow the sound to complete its initial decay to the zero sustain level, there will be no sound left to go into final decay.



Timbre 3-8

As you can see, and hear, this is a far more complex sound and requires eight voices: four for the partial timbres and four more for the chorus effect.

You may wish to solo the partial timbres as you study the figure.

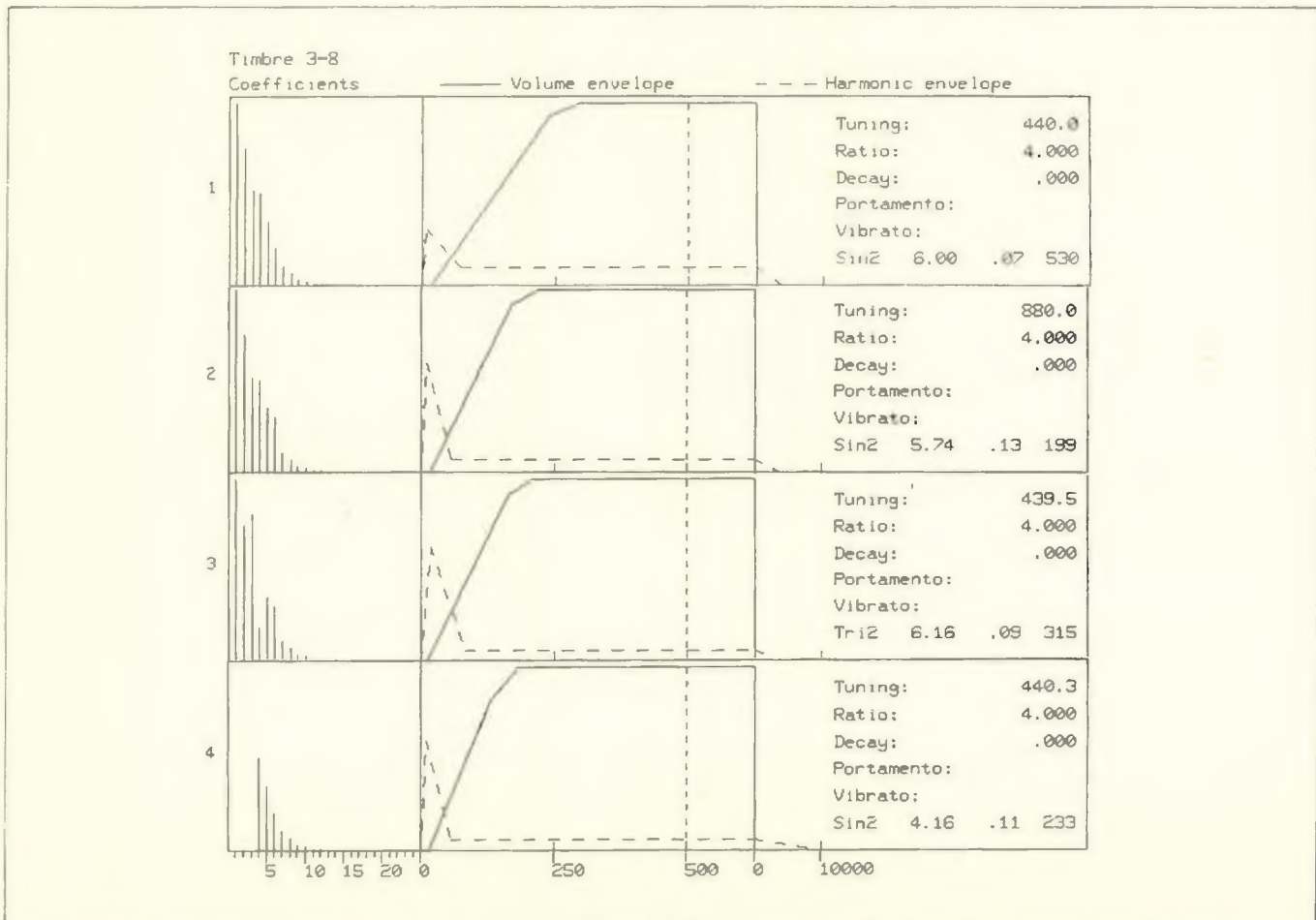
In the left-hand windows, you will see the rich harmonic content of the partial timbres. Note that in partial timbre 4, the fundamental and next two harmonic coefficients have been set at zero.

In the right-hand windows, you will see that the relationship between the volume and harmonic envelopes is similar in all four partial timbres.

There are short initial delays in the volume envelopes, but not in the harmonic envelopes. Therefore, the FM levels are already above zero when the note begins. The FM levels rise to peak during the attack interval, and then fall, during the initial decay interval, to sustain. But the volume levels rise during the initial decay period from peak to sustain. The harmonic envelopes have much longer final decays than do the volume envelopes. Thus, there will be FM when the sound of the note ends.

In the right-hand panels you will see that the tunings are different for each partial timbre. The tunings for partial timbres 1, 3, and 4 hover around 440. Partial timbre 2 has been tuned an octave higher.

The Ratio is 4.00 for all partial timbres. The vibrato shape, rate, depth, and attack are different for each partial timbre. There is no decay and no portamento.



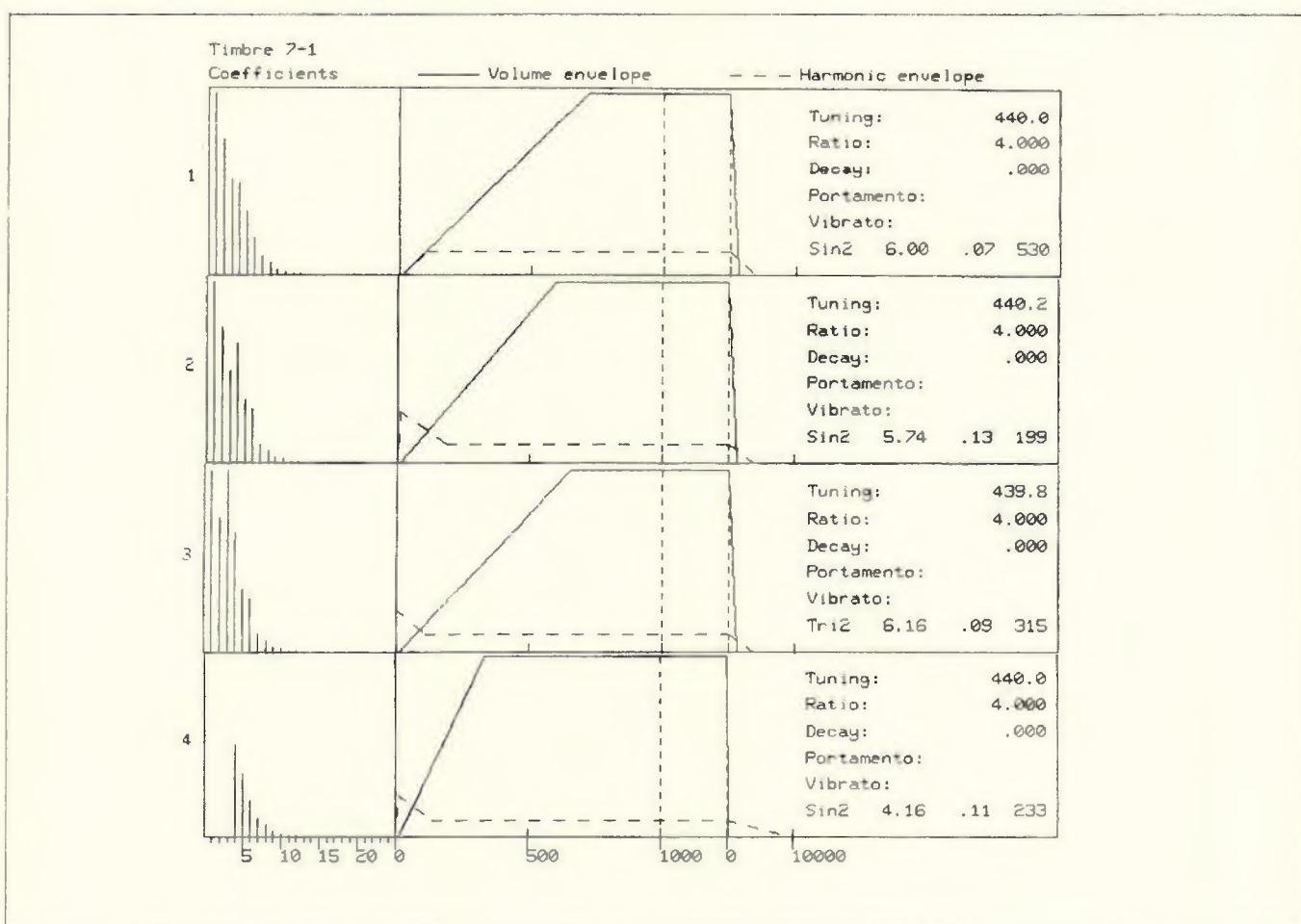
Timbre 7-1

In this timbre, the harmonic spectra of the partial timbres are similar to those in Timbre 3-8.

In all the volume envelopes, you will see the following pattern. During the initial decay, the volumes will rise at different rates to sustain level. There is a fairly long final decay period. If you strike another key during final decay, the amplitude will have to fall during the attack time to peak again at zero.

With the exception of partial timbre 1, the harmonic content is heavier in the attack portion of the sound than in the sustain portion.

Note the tunings, the Ratio, and the vibratos.



STORING TIMBRES ON DISKETTE

No matter how many modifications you make on a timbre recalled from diskette, you can always get back to the original sound by pressing the TIMBRE ENTRY button again. But, you will want to store your own new sounds so that they too can be recalled.

You can use any of the timbre diskettes or system diskettes for storage of new timbres. Since you received a duplicate copy of each diskette, you should have plenty of room for many new sounds.

When you do run out of space, you can purchase blank diskettes from New England Digital for additional storage. These will need to be formatted and duplicated before use. For Instructions on these procedures, see "Formatting and Duplicating Diskettes" in the Appendix of this manual or the "Utility Programs Manual" in this binder.

STORING A TIMBRE

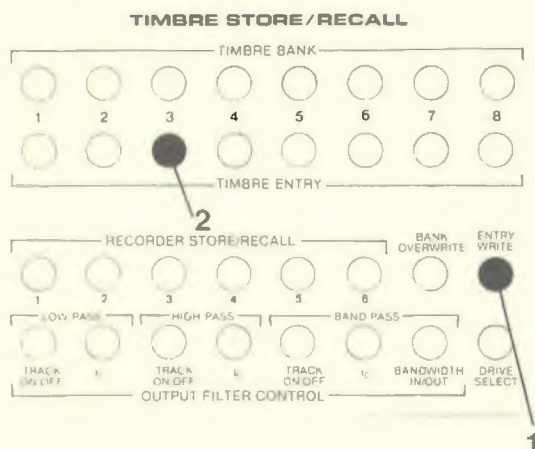
Storing a sound is simple. First remove the system diskette and insert the timbre diskette on which you want to store the sound. Next press the TIMBRE BANK button of the bank on which you wish to store the timbre. Remember, none of these procedures will affect the keyboard timbre. Then press the ENTRY WRITE button, which is located on the far right lower panel. *While holding it down*, press the desired TIMBRE ENTRY button. As soon as the disk drive motor starts up and stops, your new timbre will be stored on diskette and can be recalled from that bank and entry at any time. Whatever was there before, however, has been erased forever so be careful when you choose the location for storing a new sound.

Be sure to press the ENTRY WRITE button *before* the TIMBRE ENTRY button. Otherwise, you will recall that timbre to the keyboard and lose the sound you wanted to store.

In a dual drive system, you can store timbres on the diskette in the right-hand drive. First press the BANK button for the bank in which you want to store the timbre. Then press the DRIVE SELECT button, the ENTRY WRITE button, and the TIMBRE ENTRY button in that order.

You might want to keep a special working diskette just for developing timbres. As you make modifications, you store each change on the working diskette so that you can always return to a previous stage in the development. Once the sound is finalized and ready for use in performance, you can transfer it to a permanent place in your library of timbres.

For further insurance, it's a good idea to make duplicate copies of any diskettes containing valuable timbres. (See "Formatting and Duplicating Diskettes on Synclavier® II.")

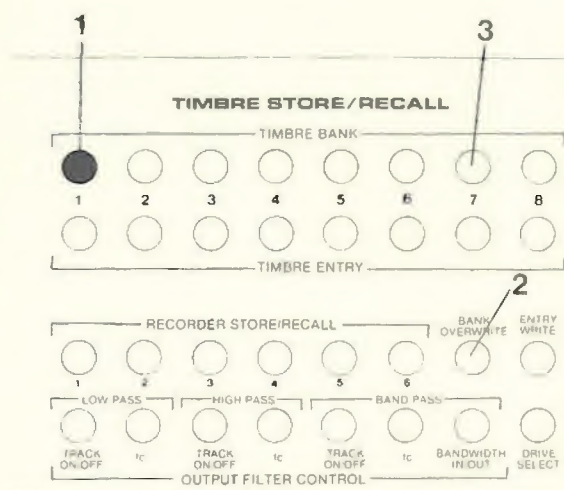


COPYING AN ENTIRE BANK

You can also copy an entire bank of sounds from one diskette onto another. First place the bank you wish to copy in computer memory by pressing the appropriate TIMBRE BANK button. Then remove the diskette from the disk drive and replace it with the diskette on which you want to store the bank.

Now, press the BANK OVERWRITE button and, while holding it down, press the TIMBRE BANK button corresponding to the bank onto which you wish to copy.

Once the disk motor has stopped, the entire bank of eight timbres will be written on the new diskette.



The standard Western scale divides the octave into twelve pitches with an equal interval, the semitone, between each pitch. The five octaves of the Synclavier® II keyboard are based on this equal-tempered scale. The A above middle C on the keyboard is assigned the standard frequency of 440.0 hertz and the frequency of notes above and below middle A are computed by using the mathematical ratio 1.059462.

Whenever you load the Synclavier® II operating system, the keyboard will be perfectly tuned in this way, regardless of changes in temperature or humidity. But you can quickly change the tuning of the Synclavier® II to play along with analog or acoustic instruments.

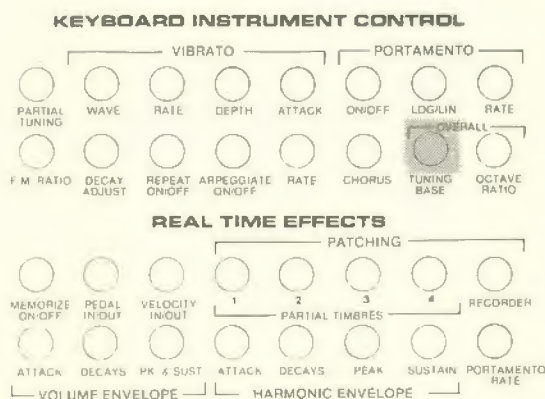
You can also change the intervals between the notes and establish special tunings.

OVERALL TUNING

You can change the overall pitch of the keyboard by pressing the TUNING BASE button in the third panel and turning the control knob. Middle A, the tuning base, can be tuned in .1 hertz intervals to any frequency between 00.0 and 1760 hertz.

This tuning will remain in computer memory and will affect any notes you play in real time and any sequences you recall from diskette and play back.

When you tune Synclavier® II, you change it to an out-of-the-ordinary tuning for a special situation, rather than adjust it to standard pitch as you do with acoustic instruments. Synclavier® II is automatically tuned to standard pitch. Therefore, changes in overall tuning are not saved when you store a sequence on diskette. And when a sequence is recalled, it will be played in the current tuning.



Changing the Tuning

1. Press TUNING BASE.

The TUNING BASE button will light up. The number 440.0 in the digital display window indicates that the overall pitch of Synclavier® II is tuned to A — 440 hertz.

2. Now, turn the knob to the left to lower the pitch; turn it to the right to raise it.

You will hear the changes instantly.

3. Press TUNING BASE again.

The number in the digital display window will now be 880.0.

Besides doing precise tuning with the knob, you can use the TUNING BASE button itself to make instant octave changes in pitch. The first time you press TUNING BASE, you assign the overall tuning function to the control knob. Each additional time you press TUNING BASE, you will step the tuning in octaves through the cycle

110.0 220.0 440.0 880.0 1760.0 Hz

4. Be sure to return to A — 440 tuning when you finish experimenting. The last tuning you establish will remain in effect on the keyboard for any new notes you play in real time or for any sequences you recall from the diskette and play.

OCTAVE RATIO

In Synclavier® II, the octave ratio determines the relationship between the keyboard octave and the actual tonal octave. With the standard octave ratio of 1.000, every keyboard octave will also produce the perfect tonal octave, or a doubling in frequency. By changing this ratio, you can expand or contract the frequency range defined by the keyboard octave, and at the same time the interval between any two adjacent keys as well as the overall range of the keyboard. The pivot pitch around which the range will expand or contract is middle A (440.0).

To change the octave ratio, you press the OCTAVE RATIO button (located in the third panel of buttons under OVERALL) and dial a new ratio between .000 and 4.000. If you dial a ratio of 4.000, there will be a frequency range of four octaves for every keyboard octave and the interval between any two adjacent keys will be one-third of an octave, or four semitones. If you dial a ratio of 2.000, there will be a range of two octaves for every keyboard octave; the interval between any two adjacent keys will be one-sixth of an octave, or a whole tone.

Microtonal scales can be established by dialing octave ratios of less than 1.000. With an octave ratio of .0000, every key on the keyboard will produce the same pitch.

The table below lists the OCTAVE RATIO settings for various intervals between adjacent keys on the keyboard.

INTERVAL	SETTING
Semitone	1.000
Whole-tone	2.000
Quarter-tone	.500
Microtones	.001 to .999

The octave ratio will remain in computer memory until you change it, recall a sequence from diskette, or turn off the system. You can re-establish the equal-tempered scale at any time by pressing the OCTAVE RATIO button twice or the SCALE RESET button (located in the lower left corner of the control panel) twice. When you store a sequence on diskette, the current octave ratio will be saved along with it.

Establishing Quarter-Tone and Whole-Tone Scales

Recall Timbre 1-1.

1. Press OCTAVE RATIO.

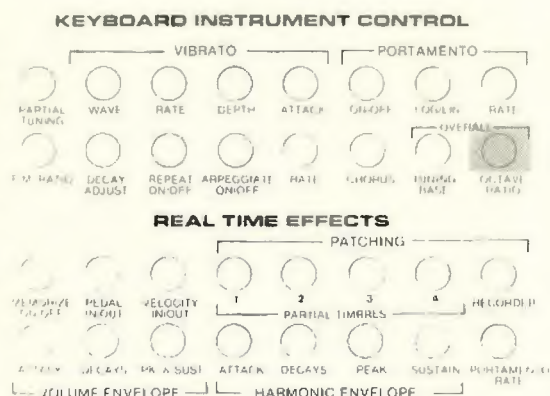
The number 1.000 in the digital display window indicates the standard octave ratio.

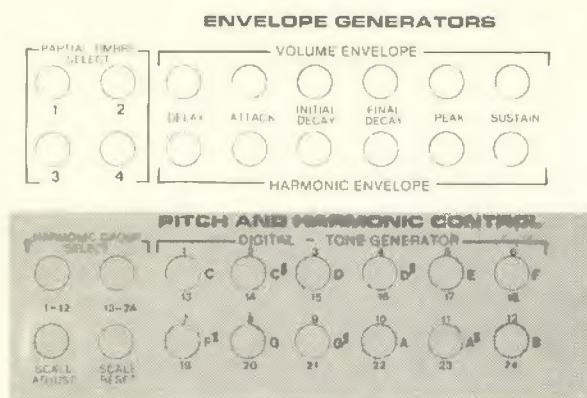
2. Dial .500.

The interval between any two keys on the keyboard is now half of a semitone, a quarter tone.

3. Dial 2.000.

Now the interval between any two keys is a whole tone.





SPECIAL SCALES

Besides changing the intervals between all the keys, you can change the relative pitch of any of the notes within the scale. Consider the octave on the keyboard that starts with middle C. The fundamental frequencies of the notes produced by each of these twelve keys can be seen in the table below.

C	261.6
C#	277.1
D	293.7
D#	311.1
E	329.5
F	349.3
F#	370.1
G	391.9
G#	415.5
A	440.0
A#	466.1
B	493.9

Since the C above middle C has a fundamental frequency of 523.0 hertz, we can say the middle octave spans the frequency range of 261.6 to 523.0 hertz.

Each of these twelve keys can be assigned any frequency in the middle octave range. To dial in a new scale, you use the buttons under PITCH AND HARMONIC CONTROL in the first panel of buttons. (These twelve buttons have triple functions, reflected by their labeling: they each control two separate harmonics and one pitch.) First you press the SCALE ADJUST button to assign the pitch control function to the twelve buttons. Next you press a PITCH CONTROL button and turn the control knob to change the pitch of the middle octave key with the same letter. The frequencies of the same note in all other keyboard octaves will be changed to preserve the octave intervals. However, the other pitches in the scale will remain unaffected.

The adjusted tunings will be stored in computer memory until you turn off the system, change the tunings, recall a sequence, or press the SCALE RESET button twice. Pressing SCALE RESET twice restores the tempered tuning up and down the keyboard. Pressing either HARMONIC SELECT button simply reassigns the function of the twelve PITCH AND HARMONIC CONTROL buttons. It will not change the adjusted tunings.

Unlike overall tuning, you can save special scales on diskette for using at a later time. Whenever you store a memory recorder sequence on diskette, the current scale is also stored. You can save the adjusted scale as a sequence on the diskette, even if there are no actual notes played in the sequence.

There are many systems of tuning and temperament* which can be precisely created on Synclavier® II. The exercise below shows you how to dial in a just tuning in the key of D.

*See J. M. Barbour, *Tuning and Temperament*, (Michigan State College Press, East Lansing, 1953).

Establishing a Just Tuning in the Key of D

Recall Timbre 1-3. We chose this timbre for the tuning exercise because it's easier to hear changes in tuning when the third and fourth harmonics are present in a sound.

1. Press SCALE ADJUST.

The SCALE ADJUST button will light up and the HARMONIC GROUP SELECT button will go out. These buttons will now be assigned to the twelve pitches of the middle octave, rather than to the harmonic coefficients of the keyboard partial timbre.

2. You will see a pitch letter to the right of each button. Press the button labeled A.

The number 440.0 in the digital display window indicates that the A above middle C is tuned to 440.0 hertz.

The programmable frequency range for this key, and for all the others in the middle octave, is from 261.6 through 523.0 hertz.

The frequencies of the other eleven keys in the middle octave will remain unchanged as you tune A.

3. While holding down the D and the A keys on the keyboard, slowly dial 440.5 hertz.

You will be able to hear the interval transform from the equal tempered tuning into the acoustically pure fifth.

4. Play the other A's above and below on the keyboard. You will notice that all the A keys *track* middle A as you change its frequency. Their frequencies will remain a perfect octave apart.

5. Now press the A button twice.

The A keys will return to the tempered tuning.

6. Now press the F# button under PITCH CONTROL.

7. While holding down the D and the F#, tune the F# to 367.7.

The interval between the D and the F# will become the acoustically pure major third.

8. Now press button 1 under HARMONIC GROUP SELECT.

The twelve buttons to the right will now control the first twelve harmonics in the partial timbre. The adjusted scale will be kept in computer memory and will continue to affect the sound triggered by every F# key on the keyboard.

9. Press SCALE RESET twice.

The complete equal-tempered scale will be restored.

At any time, perhaps after a particular passage in a composition, you can instantly return to the equal-tempered scale by pressing the SCALE RESET button twice.

For your convenience, we have included a few tables which list specific settings for just intonation in the key of C and the key of A, as well as Pythagorean and mean-tone tuning for the key of A.

The first table below indicates Synclavier® II settings for just intonation for two chromatic scales. The frequencies in each list are all relative to the base frequency, C — 261.6 or A — 440.0. Note in the C scale: the A relative to C as a base frequency is 436.0. Note in the A scale: the frequencies for pitches above B# were calculated using the appropriate ratios and were then divided by two in order to arrive at settings within the middle octave range. The actual frequencies of those upper tones are listed in parentheses. Note in both scales: when enharmonically equivalent tones (such as C sharp and D flat) differ in pitch, you must choose one or the other for tuning.

JUST INTONATION FOR TWO CHROMATIC SCALES

BASE OF C	RATIO	BASE OF A
C = 261.6		A = 440.0
C# = 272.5	25/24	A# = 458.3
Df = 279.0	16/15	Bf = 469.3
D = 294.3	9/8	B = 495.0
D# = 306.5	75/64	B# = 515.8
Ef = 314.1	6/5	C = 264.1 (528.0)
E = 328.1	5/4	C# = 275.1 (550.0)
F = 348.8	4/3	D = 293.3 (586.7)
F# = 368.0	45/32	D# = 309.3 (618.8)
G = 392.4	3/2	E = 330.0 (660.0)
G# = 409.0	25/16	E# = 344.0 (687.5)
Af = 418.5	8/5	F = 351.9 (704.0)
A = 435.9	5/3	F# = 366.7 (733.3)
Bf = 470.9	9/5	G = 396.1 (792.0)
B = 490.6	15/8	G# = 412.6 (825.0)

— sharp f — flat

The following table shows Synclavier® II settings for just, mean-tone, and Pythagorean tuning for *diatonic* scales in the key of A. The standard equal temperament tuning is listed for comparison.

FOUR DIATONIC SCALES IN KEY OF A

	EQUAL TEMP.	JUST INTON.	PYTHAG- OREAN	MEAN TONE	
C#	277.1	275.1	278.5	275.3	
D	293.7	293.3	293.3	optional	
E	329.5	330.0	330.0	329.1	
F#	370.1	366.7	371.2	368.0	
G#	415.5	412.6	417.7	optional	
A	440.0	440.0	440.0	440.0	tuning base
B	493.9	495.0	495.0	492.1	

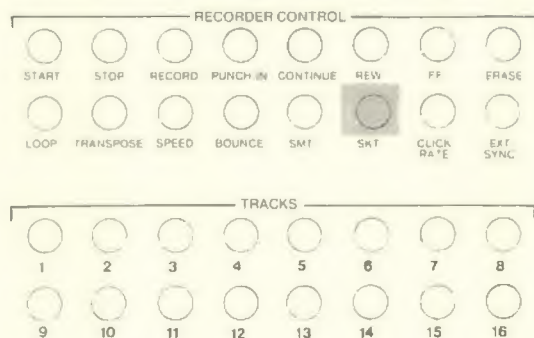
In the mean-tone scale in the key of A, the tuning of D and G# varies according to the taste of the performer.

MORE ON TUNING

You can combine the octave ratio and scale adjust functions. If you have changed the range of the middle octave by establishing a different octave ratio, the PITCH CONTROL buttons will still change the pitch of the keys with the same letter as the button. Frequency intervals will be contracted or expanded by the octave ratio.

You can also use the TUNING BASE button to adjust the overall pitch of a keyboard that has been redefined by the octave ratio and scale adjust functions. The entire keyboard of frequencies, with any established overall range or scale relationships, can be tuned up or down in .1 hertz increments.

16 TRACK DIGITAL MEMORY RECORDER



The Synclavier® II keyboard can be split into upper and lower sections with a different timbre active on each section. You can selectively replace either timbre and choose the key on the keyboard where you want the timbre to change.

To establish a split keyboard, you use the SKT button, the keyboard, and the TIMBRE BANK and ENTRY buttons.

Pressing the SKT button once and then an ENTRY button will place the selected timbre on the upper keyboard (all notes from middle C up). Pressing the SKT button twice and then an ENTRY button will place the selected timbre on the lower keyboard (all notes below middle C). Middle C is the default split point, or bottom key in the upper keyboard. You can change the split point by pressing a key on the keyboard after you press the SKT button but before you press the ENTRY button. To change the split point without changing either timbre, press SKT, then a key on the keyboard, and finally the STOP button.

Use the split keyboard in real time only, because notes played by the lower timbre cannot be recorded in the memory recorder.

Try the following exercises.

Recall Timbre 3-5. The timbre will be active on the entire five octaves of the keyboard.

Splitting the Keyboard by Changing the Lower Timbre

1. Press SKT *twice*.

The SKT button, the 16 track buttons, and the eight TIMBRE ENTRY buttons will start blinking.

2. Press TIMBRE ENTRY 6.

The blinking lights will all go out.

3. Play up and down the keyboard.

The keyboard has been split. Timbre 3-5 remains active on the upper three octaves; Timbre 3-6 is active on the lower two octaves.

Changing the Upper Timbre

1. Now press SKT *once*.

2. Press TIMBRE ENTRY 7.

Now Timbre 3-7 is active on the upper three octaves; Timbre 3-6 will still be active on the lower two octaves.

3. Press TIMBRE ENTRY 6.

By failing to press the SKT button first, you have eliminated the split point. Timbre 3-6 is active on the entire keyboard.

Changing the Split Point

1. Press SKT once.
2. Next press the C below middle C on the keyboard.

This establishes the new split point.

3. Press TIMBRE ENTRY 7.

Timbre 3-7 will now be active on the upper four octaves. The C below middle C is the new split point, or lowest note in the upper keyboard.

This split point will be saved in computer memory until you change it or eliminate it.

4. Press SKT twice, then the F above middle C on the keyboard, and then STOP.

You have established another split point. You can either press SKT once or twice before changing the split point.

The Synclavier® II offers several pitch bend options. You can use the optional ribbon controller or the control knob to perform pitch bend on all sounds triggered from the keyboard or the memory recorder. Furthermore, you can change the sensitivity of the ribbon controller or the control knob and increase or decrease the pitch bend range.

PROGRAMMING PITCH BEND SENSITIVITY

The sensitivity of the ribbon controller and the maximum depth of pitch bend on the control knob are both programmed by pressing the SCALE RESET button and turning the control knob. (Note that this button has a dual function: resetting adjusted scales and activating pitch bend.)

When you first press SCALE RESET, the number in the digital display window will be 2.00, indicating a sensitivity of two semitones per inch of movement on the ribbon controller or a range of two semitones in either direction on the control knob.

While holding down the SCALE RESET button, turn the knob to the right to increase the range of pitch bend. Turn the knob to the left to decrease the range of pitch bend. The maximum setting is 24.00, or two octaves. The minimum is .01, or one tenth of a semitone. Do not use the negative numbers for this purpose.

Your new setting will be stored in computer memory. When you release the SCALE RESET button, you may perform pitch bend in the new range either with the ribbon controller or the control knob.

For Quick Changes in Settings

After you press SCALE RESET the first time, each time you press it again you will increase the setting in the window to the next whole semitone. At 12.00 semitones, the setting will cycle back to 1.00. Use this method to change pitch bend depth, or ribbon controller sensitivity, quickly.

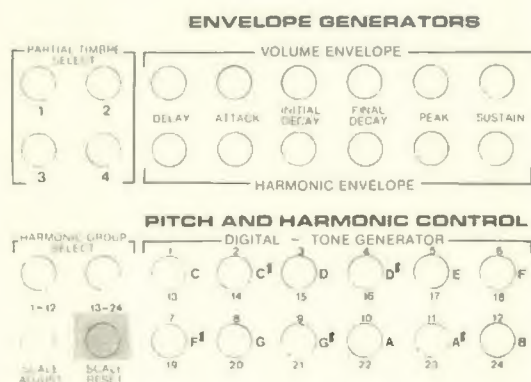
PERFORMING PITCH BEND WITH THE CONTROL KNOB

Once you have established the maximum pitch bend depth, release the SCALE RESET button. You are now in the knob pitch bend mode. The control knob may now be used to perform pitch bend on any note, in any timbre, that you play on the keyboard. You can also activate the knob pitch bend mode directly, without stopping to establish a new pitch bend depth, by simply pressing the SCALE RESET button *once*.

Turn the knob to the right to increase the pitch of the notes being played and turn the knob to the left to lower the pitch. Turning the knob all the way to the right or the left will raise or lower the pitch the maximum pitch bend depth.

The SCALE RESET button will blink whenever the knob pitch bend mode is active.

To leave the knob pitch bend mode, press any other button on the Synclavier® II control panel that affects timbre control (such as any button under VOLUME ENVELOPE or HARMONIC ENVELOPE).



PERFORMING PITCH BEND WITH THE RIBBON CONTROLLER

The Synclavier® II ribbon controller is active as long as the Synclavier® II operating system is loaded in computer memory. By sliding your finger back and forth on the sensitive surface of the controller you can produce a continuous change in pitch.

First you must trigger a sound by pressing a key or keys on the keyboard. Wherever you next touch your finger on the ribbon controller becomes the new pivot point for the pitch. Moving your finger to the right will increase the pitch from the pivot point. Moving your finger to the left will decrease the pitch. In either case the ribbon controller will respond to your touch with the programmed sensitivity.

When you release your finger from the ribbon controller, each active partial timbre will return to the pitch of the pivot point at a rate determined by their individual PORTAMENTO RATE and LOG/LIN settings. This is true whether or not the partial timbres have active portamento as set by the PORTAMENTO ON/OFF button.

ADDITIONAL NOTES ON PITCH BEND

Pitch bend may only be performed in real time. You can perform it on keyboard performances or on recorded sequences. But you cannot record it.

The ribbon controller has a separate ribbon output which can be used to control external oscillators and/or filters. There is also a separate input jack which allows the pitch of the Synclavier® II's partial timbres to be controlled from an external voltage source or analog sequencer.

The foot pedals provide additional control over the Synclavier II synthesizers beyond the functions available on the control panel. One pedal can be used for overall volume control and the other for real-time changes in the partial timbres or for vibrato depth control. The VOLUME output jack on the pedal can be connected to a variety of jacks on the back of the keyboard unit.

OVERALL VOLUME

Overall volume control is straightforward. Simply connect the VOLUME output jack of the pedal to the OVERALL VOLUME input jack on the back of the keyboard unit and turn the pedal's power switch on. If a pedal is connected to the VOLUME input jack and is not turned on, no sound will be heard. Nor will there be any sound while the pedal is in the "up" position.

To increase the volume, push the pedal down. Maximum volume is reached when the pedal is pushed all the way down. Volume changes will occur instantly, even in the middle of a note.

You can use the pedal for overall volume changes during keyboard performances or during play back of sequences in the memory recorder. You cannot *record* overall volume changes.

REAL-TIME EFFECTS

You may use the foot pedal for fluid, mid-performance changes in the parameters of any or all partial timbres active in the keyboard timbre. You press buttons to select the parameters you wish to change, such as attack time, harmonic sustain level, or portamento rate. Then, while playing, you use the pedal to make the actual changes exactly when you want them.

PROGRAMMING FOR REAL-TIME EFFECTS

To program a timbre for real-time pedal changes, you use the buttons under REAL TIME EFFECTS in the third button panel.

All these buttons are on/off buttons.

First press the numbered buttons under PATCHING to select the partial timbres you wish to change with the pedal. You can press from one to four of these buttons.

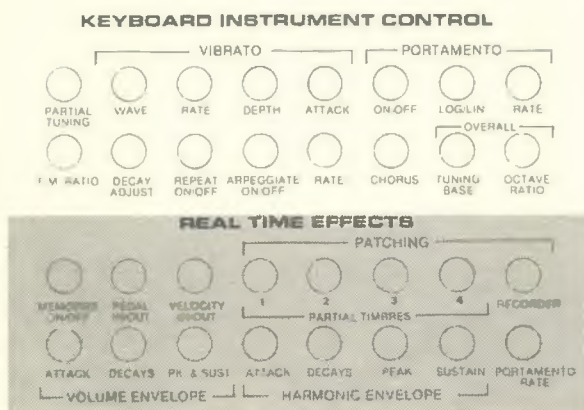
Once you have selected the partial timbres, then you use the buttons in the bottom row to select the REAL TIME EFFECTS (RTE) parameters.

There are three volume envelope buttons: ATTACK, DECAYS, and PK. & SUST. If the ATTACK button is lit, the pedal will change the attack time. If the DECAYS button is lit, the pedal will change the length of both the initial and final decays. And if the PK. & SUST. button is lit, the pedal will change the peak and sustain levels. You cannot add delays with the pedal.

The harmonic envelope buttons include separate PEAK and SUSTAIN buttons. This allows you to change the harmonic peak level and not the sustain level or vice versa.

If the PORTAMENTO RATE button is lit, the pedal will change the portamento rate.

You can press as many of these buttons as desired. The pedal will change all selected parameters at the same time.



When you have selected the desired partial timbres and the desired parameters, you press the PEDAL IN/OUT button to complete the "patching." If at least three buttons are lit (one partial timbre button, one RTE parameter button, and PEDAL ON/OFF), then the MEMORIZE ON/OFF button will light up indicating that the timbre has been "patched."

You can store the timbre in its patched form on diskette or use it immediately on the keyboard with the pedal. Until the pedal is connected to the keyboard unit, the RTE parameters will be disregarded by the Synclavier® II system.

OPERATING THE PEDAL

To control real-time effects with the pedal, you connect the VOLUME output jack to the jack labeled REAL TIME EFFECTS on the back of the keyboard unit and turn the power switch of the pedal on.

When the pedal is in the "up" position, all selected RTE parameters will be set at 0 for all selected partial timbres. For example, if the volume PK. & SUST. button is lit and the pedal is "up," when you press a key on the keyboard, the note will not sound at all. The peak and sustain volume levels have been temporarily set at zero.

As you press the pedal down, the values for the selected RTE parameters will be gradually increased. When the pedal is all the way down, the RTE parameters will equal the time intervals or levels originally dialed in on the partial timbre.

All RTE changes are effective at the beginning of each new note. If you move the pedal during a note, the change will not be heard until you play the next note on the keyboard.

As mentioned above, you can change more than one RTE parameter at once. If the times or levels of the parameters you wish to change are different, the pedal will change them all as a group, increasing or decreasing them all by the same ratio.

Try the following exercises.

Changing the Peak FM Level

Connect the VOLUME output of the pedal to the REAL TIME EFFECTS jack on the back of the keyboard unit. Turn on the pedal.

Recall Timbre 1-2.

1. Press all four PARTIAL TIMBRE buttons under PATCHING.

The four buttons should light up. You are going to change all four partial timbres.

2. Press PEAK over HARMONIC ENVELOPE in the row below.

It should light up.

3. Press PEDAL IN/OUT.

It should light up as should the MEMORIZE ON/OFF button.

4. Push the pedal to its "up" position.

5. Depress a key on the keyboard.

The bell sound will ring dully. The harmonic peak level is zero.

6. Gradually push the pedal to its "down" position as you tap a key on the keyboard.

The attack of the sound will get brighter each time you press the key. Maximum harmonic peak level will be reached when the pedal is all the way down.

Changing the Volume Decay Time and the FM Peak Level

Continue with the same "patched" timbre.

1. Now press DECAYS over VOLUME ENVELOPE.
2. Push the pedal to its "up" position and tap a key on the keyboard.

The harmonic peak level is zero and the volume initial and final decay times are also zero. Since the volume sustain level of these partial timbres are all zero, you will just hear a clicking sound.

3. As you continue to tap a key on the keyboard, gradually push the pedal down.

The attacks will get brighter and the decays will get longer. The pedal is now controlling the FM peak level and the volume decay times.

Changing the FM Peak Level, the Volume Decay Times, and Overall Volume Level

Continue with the same timbre.

1. Press the PK. & SUSTAIN button located over VOLUME ENVELOPE.
2. Push the pedal to its "up" position and tap a key on the keyboard.

You will hear nothing at all. Volume level is set at zero.

3. While tapping a key on the keyboard, gradually push the pedal all the way down.

The volume of each successive key depression will get louder. The FM peak level will increase. And, the volume decay times will get longer.

Experiment with different parameters and different timbres.

CHANGING TIMBRES DURING PLAYBACK

If the timbres in a sequence have real time effects parameters patched in, you can modify them during playback. Before pressing START, press the RECORDER button under PATCHING.

Then, the pedal will change every selected RTE parameter for every selected partial timbre on every track in the recorder.

RECORDING REAL-TIME EFFECTS

Although many synthesists prefer to improvise with real-time effects during live performance only, you can record these changes in timbre in the memory recorder. To do so, connect the pedal and patch in the desired RTE parameters before pressing RECORD. All the changes you make with the pedal will be recorded.

If you choose to record real-time effects changes, you will find that there will be fewer notes available in the memory recorder. Because of the extra memory required to store the additional information, each recorded note with RTE patching will use up two notes in the memory recorder.

Note that the SCRIPT system lets you specify extremely precise, note by note RTE changes for recorded sequences.

Recall "Scarborough Fair" and try the following exercises.

Recorded Real-Time Effects

1. Solo and play track 1.

You will hear recorded changes in bowing strength. The pedal was used during recording to change the HE PEAK on partial timbres 1 and 2.

2. Solo and play track 4.

You will hear changes in the decays of the notes. The pedal was used during recording to change VE DECAYS on partial timbre 1.

3. Using the SMT button, place the timbre from track 1 on track 2; solo and play track 2.

You will now hear RTE changes on this track. These changes were specified for the notes on the track in SCRIPT. When a timbre with RTE patching is used on the track, the changes will be in effect. If the timbre has no RTE patching, the changes will be ignored.

Changing Real-Time Effects During Playback

1. Now connect the pedal to the REAL-TIME EFFECTS jack.

2. Press RECORDER under PATCHING.

The pedal will not affect recorder playback unless this button is lit.

3. Solo track 1 again.

4. Press PARTIAL TIMBRES 1 and 2 and HE PEAK under PATCHING.

5. Press START and push the pedal up and down to change the bowing strength used for the recorded notes.

Your pedal input will override the recorded pedal input.

6. Now solo track 4, press PARTIAL TIMBRE 1 and VE DECAYS under PATCHING, and use the pedal during playback.

Recording Real-Time Effects

1. Now erase the sequence.
2. Select a timbre for the keyboard and set up the desired RTE effects patching.
3. Press RECORD and use the pedal to record RTE changes.
4. Play back the sequence and listen to the changes.

There are two ways to change vibrato depth during performance. The first is with the pedal, as you have learned in the introductory section, and the second is with the control knob. In both cases, the vibrato depth for the partial timbre, as established by the VIBRATO DEPTH button and the control knob, will be the maximum vibrato depth.

This form of vibrato depth control may only be used in real time. It may not be recorded in the memory recorder.

WITH THE PEDAL

To change vibrato depth with the pedal, simply connect the pedal to the REAL-TIME EFFECTS jack on the back of the keyboard unit and turn on the power switch of the pedal. *If all the RTE parameter buttons are off*, the pedal will be automatically "patched" to vibrato depth control.

Pushing the pedal all the way down will result in the maximum vibrato depth. Lifting the pedal all the way up will result in zero vibrato depth, or no vibrato.

These changes will be effective instantly, even in the middle of a note.

You can use the pedal to vary the vibrato depths of timbres in a sequence in the memory recorder. To do so, press the RECORDER button in the REAL TIME EFFECTS panel before pressing START. Also, if there is any RTE "patching" on any of the timbres on any of the tracks, the vibrato on those tracks will not be affected. On the others, it will.

WITH THE CONTROL KNOB

The control knob may also be used to vary the depth of vibrato.

Press the SCALE RESET button and, while holding it down, turn the control knob until the digital display window reads -100 (negative one hundred). Now, when you release the SCALE RESET button, the control knob may be used to control vibrato depth (rather than to perform pitch bend as described earlier on page 000). All partial timbres active in the keyboard timbre will be affected.

When the knob is centered, there will be a vibrato depth of zero (that is, no vibrato). When you turn the control knob to the right or to the left, the vibrato depth will increase to the maximum in an easily controlled fashion. As you release the control knob, it will automatically center itself.

With a SCALE RESET setting of -100, the maximum is the VIBRATO DEPTH setting. You can quickly change the maximum by dialing another SCALE RESET setting. For example, -50 would scale the maximum depth down to half the VIBRATO DEPTH setting.

To leave this mode, press any other timbre control button on the Synclavier® II control panel.

ANOTHER TECHNIQUE WITH THE PEDAL

There is another technique for using the pedal connected to the REAL-TIME EFFECTS jack to perform pitch bend. All RTE buttons except PEDAL IN/OUT and buttons to select partial timbres must be off. Establish the following VIBRATO settings: WAVE number 10, DEPTH of 2.00 semitones, and RATE of 0.00. Now push the pedal up and down to perform pitch bend.

The two switches on the Morley pedal can be patched to any of seven Synclavier® II functions: punch in, portamento, arpeggiate, repeat, hold, sustain, and pitch bend. All except pitch bend can be used both during real-time performance and recording. Pitch bend can only be used in real time.

You learned how to use the foot switch for punching in on page 39 in the chapter on "Creating Sequences." The other functions are described below.

PORTAMENTO

Connect either switch output jack on the pedal to the jack labeled PORTAMENTO on the back of the keyboard unit. Next, turn the PORTAMENTO ON/OFF *button* on the Synclavier® II control panel off.

Whenever you push the foot switch, the portamento ON/OFF button will light up and portamento will be in effect. As long as you hold down the switch, the notes you play on the keyboard will slide from one to the next at the rate established in each partial timbre. As soon as you take your foot off the foot switch, the ON/OFF button will go out and the notes will no longer slide.

REPEAT and ARPEGGIATE

You can control the repeat and arpeggiate functions in exactly the same way. Connect one switch on the pedal to the jack labeled REPEAT and the other to the jack labeled ARPEGGIATE on the back of the keyboard unit. Alternately, use a Y-connector and connect one switch to both jacks so that you can turn both functions on and off together.

Turn off the appropriate ON/OFF buttons on the control panel.

As long as you hold down the switch or switches, the notes you play will repeat and/or arpeggiate automatically.

HOLD and SUSTAIN

The HOLD and SUSTAIN switches require a little more explanation as there are no equivalent buttons on the control panel. They both serve to hold notes or chords after you remove your fingers from the keys. The overall SUSTAIN switch will hold all notes. The HOLD switch will hold only the note or chord that is sounding when you first press the switch.

HOLD

Connect either switch output jack to the jack labeled HOLD on the back of the keyboard unit.

To use the HOLD function, you first hold down a key or a chord on the keyboard, and then press the foot switch. As long as you keep your foot on the switch, the sound will be held. You can play new notes, which will not be held, on top of the sound.

The sustain volume and FM levels of the active partial timbres will be used for the held sound. If the sustain volume levels are 0, there will be no sound for this switch to hold.

Holding a Chord

Connect a foot switch to the HOLD jack on the back of the keyboard unit.

Recall Timbre 3-4.

1. Play a chord on the keyboard.
2. While holding it down, press the foot switch.
3. Keep your foot on the switch and remove your fingers from the keys.

The chord will be held.

4. Play additional notes while continuing to hold down the foot switch.

The new notes will not be held.

5. Release the switch.

The chord will be cut off.

SUSTAIN

Connect either foot switch to the jack labeled SUSTAIN on the back of the keyboard unit.

All current and succeeding notes will be held as long as you hold down the switch. The volume and FM sustain levels will be used for the held sounds.

If the partial timbre volume sustain level and final decay time are both set at zero, you can also use the SUSTAIN switch much like the sustain pedal on a piano to place decays on some notes and not on others during performance. When the SUSTAIN switch is "on," your notes will be sustained for the complete initial decay time while the volume decays from peak to zero sustain level. When the SUSTAIN switch is "off", the notes will be cut off. If you change the length of the initial decay, you will change the length of the sustain.

Sustaining Notes

Recall Timbre 1-3. Connect a foot switch to the SUSTAIN jack on the back of the keyboard unit.

1. Play a chord.
2. While holding it down, press the foot switch.
3. Keep your foot on the switch and remove your fingers from the keys.

The chord will be held.

4. Now, keeping your foot on the switch, play additional notes.

They will all be held.

5. Now, release the foot switch and set the volume sustain level to .0 and the initial decay at 500.

6. Play a fast passage.

Each note will be cut off as soon as you lift your finger from the key.

7. While holding down the foot switch, play another fast passage.

Now the notes will be slightly sustained as the sound decays from volume peak to sustain level. Note that you will only be able to sustain as many different notes as you have voices in your system. Even after a note has completed its decay, it will be "held" as long as you hold down the switch and will, thus, use up a voice. Frequent releases of the pedal will overcome this situation.

8. Change the initial decay to 1000.
9. While holding down the foot switch, play more notes.
You will hear longer sustains.
10. Experiment with different initial decay times.

PITCH BEND

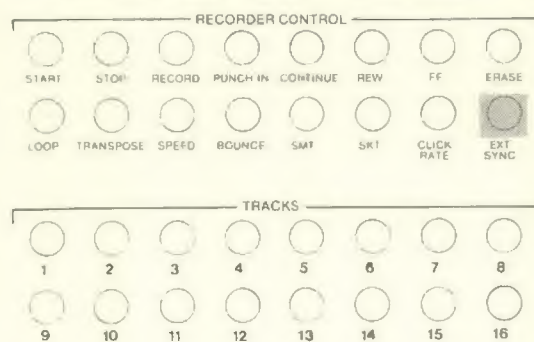
When a foot switch is connected to the jack labeled PITCH BEND on the back of the keyboard unit, the pitch of a played note will be reduced by one semitone when you press the switch.

V. STUDIO INTERFACES

This section includes information on using Synclavier® II in the studio for professional analog recording and analog synthesis.

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External Synchronization	112
Control Voltage Outputs	114
Pitch Bend Input	118

16 TRACK DIGITAL MEMORY RECORDER



The External Synchronization (EXT. SYNC.) function on Synclavier® II allows you to use an external 50 Hz synchronization signal recorded on analog tape to start and stop the Synclavier® II memory recorder. You can use this function for synchronizing Synclavier® II performances with performances on other instruments and for synchronized transfer of individual tracks from the memory recorder.

The procedure is outlined below:

- A. Record 50 Hz signal on tape.
- B. Press EXT. SYNC. on Synclavier® II.
- C. Press START on Synclavier® II.
- D. Return 50 Hz signal by starting tape.

Details follow.

A. Record 50 Hz signal on tape.

1. Connect the EXT. CLOCK (output) jack on the back panel of the computer to a track of the multitrack recorder.
2. Press START on Synclavier® II. As long as the memory recorder runs, a synchronization signal which is 50 Hz bipolar wave (approximately square) of about 1.5 volts peak to peak will be emitted from the EXT. CLOCK jack.
3. Set the recording amplitude level. The recording level should be set low enough so that the signal will not bleed onto other tracks. The exact level will vary from recorder to recorder, but a setting of approximately -5 to -10 dB below normal recording level will usually be sufficient.
4. Start recording on the tape recorder. While the memory recorder runs, the 50 Hz signal will be emitted and recorded on the tape. When you press STOP on Synclavier® II, the output will cease.

Be sure that you have enough 50 Hz synchronization signal on tape for the entire composition.

5. Stop the tape recorder.

B. Press EXT. SYNC. on Synclavier® II.

Make sure button is lit.

C. Press START on Synclavier® II.

The memory recorder will not start until it receives the 50 Hz signal.

D. Return the 50 Hz signal.

1. Place the tape recorder in the SEL-SYNC mode, with the 50 Hz track in SYNC PLAYBACK.
2. Connect the output from the 50 Hz track to the EXT. CLOCK INPUT on the back of the computer.
3. Set the playback amplitude level. Some gain will usually be necessary to bring the signal up to a level which will trigger the memory recorder reliably.
4. Rewind the tape to a point before the beginning of the 50 Hz signal.
5. Now, if you are playing back a sequence:
 - a. Start the tape recorder. As soon as the 50 Hz signal reaches the sync head of the tape recorder, the Synclavier® II recorder will start playing back. At the end of the recorded signal, the memory recorder will stop instantly.

If you are transferring Synclavier® II tracks onto the tape:

- a. Patch the audio output from Synclavier® II to the selected track of the multitrack tape recorder, either directly or via mixing console. (See "Setup Manual.")
- b. Start recording on the tape recorder. As soon as the 50 Hz signal reaches the sync head of the recorder, the playback of the sequence in the memory recorder will be triggered and will be recorded on tape. At the end of the recorded signal, the memory recorder will stop instantly.
- c. To transfer an additional track, rewind the tape to before the pulse and select the next track you wish to record on. Solo the track in the Synclavier® II memory recorder that you wish to transfer and press START. Begin recording on the tape recorder. The new track will be recorded on tape in complete synchrony with the first musical track.

Control voltage outputs from the Synclavier® II computer can be used to control equipment used in analog synthesis, such as oscillators, envelope generators, filters, etc. There are four nonprogrammable control voltage outputs and four programmable control voltage outputs. All control voltages are positive dc voltages with respect to ground.

NONPROGRAMMABLE CONTROL VOLTAGE OUTPUTS

Continuously produced control voltage outputs can be accessed through the four jacks under CONTROL VOLTAGE OUTPUTS on the back of the keyboard unit.

The jack labeled KEYBOARD GATE produces a control voltage of 10 volts whenever you press a key on the keyboard and as long as you hold the key down. When no key is depressed, the output will be 0 volts.

The jack labeled KEYBOARD TRIGGER produces a control voltage pulse of 10 volts lasting approximately 4 milliseconds whenever you press a key on the keyboard, even if additional keys are already held down.

The jack labeled KEYBOARD CV produces a range of voltage from 0 to 5 volts from left to right across the keyboard. There is a linear gain of 1 volt per octave, or 1/12th of a volt per key. The control voltage output will latch on the last key pressed and will continue at that voltage until you press a different key. If you hold down a chord and play a short note on top, this last note will determine the control voltage, rather than the held chord. It is the sequence of key depression that determines the voltage.

The jack labeled RIBBON produces a control voltage output proportional to the position of your finger on the ribbon controller. Pressing at the left end of the ribbon controller produces slightly above 0 volts. Pressing at the right end produces approximately 4 1/2 volts. When the ribbon is released, the output returns to 0 volts.

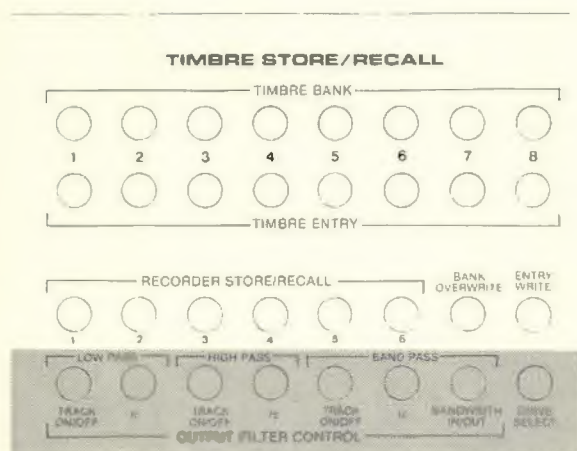
PROGRAMMABLE CONTROL VOLTAGE OUTPUTS

Synclavier® II also provides a method to program various control voltage outputs into the timbre. These programmable outputs are primarily designed for filter control during live performance, but they can be used to control other equipment used in analog synthesis.

The outputs are programmed with the OUTPUT FILTER CONTROL buttons in the fourth panel on the bottom row and are accessed through the jacks located under CONTROL VOLTAGE on the back of the keyboard unit.

The LOW PASS, HIGH PASS, and BAND PASS parameters can be programmed to produce a fixed control voltage output or to produce variable control voltage outputs which track key depressions on the keyboard. The BANDWIDTH parameter can only be programmed to produce a fixed control voltage output.

The output parameters are stored in computer memory and can be saved on diskette along with all of the other parameters that comprise a timbre.



LOW PASS

Plug into the output jack labeled LOW PASS. Press the LOW PASS fc button and dial a number between 0 and 250.

Fixed Output

If the TRACK ON/OFF light is off, the number you dial will produce a fixed control voltage output in the range of 0 to 10.4 volts. An fc setting of 0 will produce a 0-volt output, a setting of 24 will produce a 1-volt output, a setting of 48 will produce a 2-volt output, etc., up to 250 for a 10.4-volt output.

Pressing keys on the keyboard will not affect the output.

Variable Keyboard Output

If the TRACK ON/OFF light is on, the control voltage will track the key depressions on the keyboard with a linear gain of 1 volt per octave. You use the fc button and the control knob to select a particular *voltage range* rather than a fixed voltage. The number that you dial determines the voltage offset for the range.

When you dial an fc setting of 0, the keyboard voltage range will be from 0 to 5 volts. An increase of 2 in the setting will raise the voltage range and increase the voltage latched by each key by $1/12$ of a volt. If you dial a number greater than 0, the voltage latched by the lowest key will be above 0. For example, if you dial a setting of 48, the control voltage output range of the keyboard will be 2 to 7 volts.

The voltage can never exceed 10.4 volts. With a setting of 202, for instance, there will be variable control voltage output on only the lower two octaves on the keyboard. All keys to the right will produce a 10.4 volt output. With a setting of 250, all keys will produce the maximum output.

In every case, the programmed control voltage output will latch on the last key pressed and will continue at that voltage until you press a different key.

HIGH PASS

Plug into the output jack labeled HIGH PASS. Press the HIGH PASS fc button and dial a number between 0 and 250.

Fixed Output

The fixed output is programmed in exactly the same way as is the LOW PASS fixed output. If the TRACK ON/OFF light is off, the number you dial will produce a fixed control voltage output in the range of 0 to 10.4 volts.

Variable Keyboard Output

If the TRACK ON/OFF light is on, the control voltage will track the key depressions on the keyboard with a linear gain of 1 volt per octave, just as with the LOW PASS output.

With the HIGH PASS output, however, there is a two octave, built-in low note offset in the keyboard control voltage range. That is, if you dial the number 0, the keyboard control voltage outputs will remain at 0 for the first two octaves plus middle C. The keys above middle C will latch control voltage outputs in the range of 1/12th of a volt to 3 volts.

If you dial the number 48, the keyboard voltage range will be from 0 to 5 volts. If you dial a number greater than 48, the lowest key will produce a control voltage output greater than 0 volts. Every increase of 2 above 48 in the fc setting will increase the voltage latched by each key 1/12th of a volt. With an fc setting of 250, for example, the output will vary from 8.4 to 10.4 for the bottom two octaves. It will latch at 10.4 for the top three octaves.

BAND PASS

Plug into the output jack labeled BAND PASS. Press the BAND PASS fc button and dial a number between 0 and 500.

Fixed Output

The fixed BAND PASS control voltage output is affected by the LOW PASS fc setting. The control voltage established by the LOW PASS parameter is added to the voltage set by the BAND PASS parameter to produce the total voltage output.

When the LOW PASS fc is set at 0 and the BAND PASS fc is set between 0 and 250, the BAND PASS output will be 0 volts. For BAND PASS fc settings between 250 and 500, the output will increase 1 volt per multiple of 24.

Example: If LOWPASS fc is set at 0 and BANDPASS fc is set at 298 ($250 + 48$), then BANDPASS fixed output will be 2 volts. If LOW PASS fc is increased to 72 (3 times 24), the fixed BAND PASS output will be 5 volts. The maximum range with any combination of settings is, as before, 0 to 10.4 volts.

Note that an increase in the LOW PASS fc will affect the BAND PASS output but it will not affect the BAND PASS fc displayed in the window.

Variable Keyboard Output

The LOW PASS TRACK ON/OFF has priority over fixed BAND PASS output. Either LOW PASS TRACK ON/OFF or BAND PASS TRACK ON/OFF, or both, will cause the BAND PASS output to track the keyboard. Neither of the BAND PASS settings affect the LOW PASS output in any way.

If LOW PASS fc is set at 0, there will be a five octave offset in the keyboard control voltage range. BAND PASS fc settings between 0 and 130 (which is 250 minus 5 times 24) will produce control voltage outputs of 0 volts for every key on the keyboard. BAND PASS fc settings between 130 and 250 will produce control voltages greater than 0 in the upper octaves. For example, a setting of 178 will produce a BAND PASS output voltage of 0 for the three bottom octaves, and an increase of 1 volt per octave for the two upper octaves. A BAND PASS fc setting of 250 will produce a 0–5 volt keyboard control voltage range.

If the LOW PASS fc is increased, its value will be effectively added to BAND PASS fc as described in "Fixed Output" above.

BANDWIDTH IN/OUT

There is a separately programmable band pass control voltage which can be used to control the Q of an analog filter. Press the button labeled BANDWIDTH IN/OUT and dial any setting between 0 and 250.

This operates in a similar fashion to the other filter control parameters, except that there is no keyboard tracking function.

The input jack labeled PITCH BEND on the back of the keyboard unit allows the pitches of the partial timbres to be controlled by an external voltage source, for example, an analog sequencer.

It can also be used as a simple switch function whereby the pitch of all notes will be reduced by one semitone when you short the switch.

VI. APPENDIX

Contents of this Section	page
Button Summary	121
Timbre Directory	129
Error Messages	134
Formatting and Duplicating Diskettes	136
Dialing Specific Waveforms	140

BUTTON SUMMARY

121

The essential button summary and index! Tape these pages to the wall above your Synclavier® II for quick reference.

	what you do	what Synclavier® II does	page
Recalling A Timbre			
TIMBRE BANK 1-8	Press 1 button.	Loads selected timbre bank into memory.	16
TIMBRE ENTRY 1-8	Press 1 button.	Activates selected timbre on keyboard.	16
Recalling Two Timbres			
SKT	Press once, then press ENTRY button.	Establishes split keyboard, with selected timbre on upper section.	98, 99
	Press twice, then press ENTRY button.	Establishes split keyboard, with selected timbre on lower section.	
	Press once or twice, then press key, then press ENTRY button.	Establishes split keyboard, with new split point.	
	Press once, then key, then STOP.	Establishes new split point with same timbres.	

TIMBRE DEFINITION

Modifying Partial Timbres

PARTIAL TIMBRE 1-4	Press 1 or more buttons.	If the button(s) becomes lit or blinks, selected partial timbre(s) can be programmed.	19, 20
		If the button(s) blinks, selected partial timbre(s) will be soloed on keyboard.	
HARMONIC GROUP SELECT 1-12, 13-24	Press 1 button.	Assigns appropriate harmonic control function to 12 PITCH AND HARMONIC CONTROL buttons.	53, 54
PITCH AND HARMONIC CONTROL 1-12, 13-24	Press 1 or more buttons, turn knob.	Changes relative strength of selected harmonic coefficients. Range: .0 to 100.0 arb.	53-56
VOLUME ENVELOPE			61-72
DELAY	Press button, turn knob.	Changes volume delay time. Range: 0 to 9999 msec.	
ATTACK	Press button, turn knob.	Changes volume attack time. Range: 0 to 9999 msec.	
INITIAL DECAY	Press button, turn knob.	Changes volume initial decay time. Range: 0 to 9999 msec.	
FINAL DECAY	Press button, turn knob.	Changes volume final decay time. Range: 0 to 9999 msec.	
PEAK	Press button, turn knob.	Changes volume level during attack. Range: .0 to 100.0 dB.	
SUSTAIN	Press button, turn knob.	Changes volume level during sustain. Range: .0 to 100.0 dB.	

HARMONIC ENVELOPE

73-76

DELAY	Press button, turn knob.	Changes FM delay time. Range: 0 to 9999 msec.
ATTACK	Press button, turn knob.	Changes FM attack time. Range: 0 to 9999 msec.
INITIAL DECAY	Press button, turn knob.	Changes FM initial decay time. Range: 0 to 9999 msec.
FINAL DECAY	Press button, turn knob.	Changes FM final decay time. Range: 0 to 9999 msec.
PEAK	Press button, turn knob.	Changes FM level during attack. Range: 0 to 1000 arb.
SUSTAIN	Press button, turn knob.	Changes FM level during sustain. Range: 0 to 1000 arb.

PARTIAL TUNING

Press button,
turn knob, or
repeatedly press
button.Changes tuning base for partial
timbre. Range: .0000 to 1760 Hz.

80

VIBRATO

77, 78

WAVE

Press button,
turn knob, or
repeatedly press
button.Changes vibrato wave shape.
Range: Symbolic numbers for
wave shapes. 1-5, vibrato on
carrier; 6-10, vibrato on both
carrier and modulator.

RATE

Press button,
turn knob.Changes vibrato rate.
Range: .00 to 50.00 Hz.

14, 15

DEPTH

Press button,
turn knob.Changes vibrato depth.
Range: .00 to 24.00 semitones.

14, 15

ATTACK

Press button,
turn knob.Changes vibrato attack time.
Range: 0 to 9999 msec.

PORTAMENTO

79

ON/OFF

Press button.
("Light" it.)

Turns portamento function on.

Press button
again.

Turns portamento function off.

RATE

Press button,
turn knob.Changes portamento rate.
Range: .000 to 1.000 arb.

LOG/LIN

Press button.
("Light" it.)Calculates logarithmic portamento
rate.

LOG/LIN

Press button
again.
("Unlight" it.)

Calculates linear portamento rate.

F.M.RATIO

Press button,
turn knob.Changes modulator to carrier
frequency ratio. Range: 0.000
to 16.00 arb. Or for constant
modulator: -.1 to -999 Hz.

57-59, 76

DECAY ADJUST

Press button,
turn knob.Changes final decay on
lower notes. Range: .000 to
1.000 arb.

80

Modifying the Complete Timbre

REPEAT	Press button. ("Light" it.)	Turns repeat function on.	84
	Press it again.	Turns repeat function off.	
ARPEGGIATE	Press button. ("Light" it.)	Turns arpeggiate function on.	84
	Press it again.	Turns arpeggiate function off.	
RATE	Press button, turn knob.	Changes repeat and/or arpeggiate rate. Range: .00 to 100.0 Hz.	84
CHORUS	Press button, turn knob.	Establishes and tunes chorus effect. Range: .000 to 10.00 arb. A setting of 1.000 results in no chorus effect.	83
	Press button again.	Removes chorus effect by resetting parameter to 1.000.	
PARTIAL TIMBRE SELECT 1-4	Make all 4 buttons blink, turn knob.	Changes keyboard polyphony. Range: 1 to number of voices in system.	85
BOUNCE	Press button, then orig. PARTIAL TIMBRE button once, then dest. PARTIAL TIMBRE button.	Duplicates all settings from 1 partial timbre onto another.	82

MEMORY RECORDER

START	Press once.	Starts playback with first click.	24
	Press twice.	Starts playback with first note.	
STOP	Press once.	Stops recording or playback.	24
RECORD	Press once.	Starts recording on blinking track. If none are soloed, Synclavier® II will select first track with same timbre as on keyboard, or first empty track.	27, 28
PUNCH IN	Press once.	Starts erasing and recording on soloed track. Stops playback.	38, 39
	Press again.	Stops erasing and recording. Continues playback.	
CONTINUE	Press once.	Continues playback from point in mid-sequence.	24
		Also arms the system for various loops and Dal segno points.	43-45
REW.	Press once.	Plays back in reverse, fast.	24
F.F.	Press once.	Plays forward, fast.	24
ERASE	Press twice	Erases sequence in memory recorder.	27
	or press TRACKS button and then ERASE.	Erases soloed track.	28
LOOP	Press once at loop point	Returns to first note, plays to loop point until you press STOP.	29, 41-45
	or hold down TRACKS button, then press LOOP.	Establishes independent loop.	

TRANSDPOSE	Press button, press key.	Transposes sequence based on interval of key to middle C.	30, 43, 46
		If track is soloed, transposes only track.	
SPEED	Press button again.	Takes keyboard out of transpose mode.	
	Press button, turn knob.	Changes recorder speed. Range: .00 to 10.00 times recording speed.	40, 41
BOUNCE	Press button, then orig. TRACKS button once, then dest. TRACKS button.	Performs erasing bounce.	37
	Press button, then orig. TRACKS button twice, then dest. TRACKS button.	Performs nonerasing bounce.	
SMT	Press button, then TRACKS button, then either:	Plays notes on selected track with:	26, 46-48
	SKT or TRACKS or TIMBRE ENTRY	keyboard timbre or timbre from track or timbre from bank.	
SKT	Press button, then TRACKS button.	Activates track timbre on keyboard.	47
CLICK RATE	Press button once or twice,	If button becomes lit, turns on click track output. If button starts blinking, turns off click track output.	34
	turn knob.	Changes click rate. Range: 6.0 to 2400 clicks per min.	
EXT. SYNC.	Press button. ("Light" it.)	Waits for external synchronization pulse to trigger memory recorder.	112, 113
	Press button again.	Resumes normal operation of memory recorder.	

KEYBOARD CONTROL

Tuning

TUNING BASE	Press button, turn knob.	Changes overall pitch in .1 Hz increments. Range: 00.0 to 1760 Hz.	92
	Or repeatedly press button.	Makes octave jumps in tuning.	
OCTAVE RATIO	Press button, turn knob.	Changes octave ratio. Range: .0000 to 4.000.	93
SCALE ADJUST	Press button.	Assigns pitch control function to 12 PITCH AND HARMONIC CONTROL buttons.	94
PITCH AND HARMONIC CONTROL, C-B	Press one button, turn knob.	Changes pitch of selected key. Range: 261.6 to 523.0 Hz.	94, 95
	Press button again.	Restores tempered tuning for that pitch.	
SCALE RESET	Press twice.	Restores tempered tuning for all pitches.	93, 94

Pitch Bend

SCALE RESET	Hold down, turn knob.	Changes pitch bend sensitivity. Range: .01 to 24.00 semitones.	100
	Release button and turn knob.	Activates knob pitch bend mode as long as SCALE RESET is lit.	
	Repeatedly press button.	Increments pitch bend sensitivity by semitones, 1.00 through 12.00.	

SYSTEM DISKETTE (INSTRUCTION TIMBRES)

	ENTRY							
	1	2	3	4	5	6	7	8
1	-1- Sine Wave*	-4- Church Bell*	-1- Organ*	-4- Hammond w/"fft"***	-8- Hammond (bright or dark)**	-1- Vibes #1*	-2- Hammond**	-1- Woodwind Source*
2	-4- Oboe Source*	-3- 3 Partial Example*	-1- Rock Wow	-1- Portamento Example*	-2- Phone (Bf3)**	-1- Electric Piano #1	-8- Major Chord w/delays	-1- Percussion Source*
3	-1- Bell*	-4- Harpichord w/Hammond**	-2- Glissando w/repeat	-1- HOLD Example*	-1- Vibes #2*	-1- Bass #1*	-2- Flute	-8- Orchestral Strings
4	-1- Calimba #1*	-2- Keyboard Lead**	-4- Strummed String Instrument	-4- Repeat w/delay	-1- TDS Example	-2- Just & Equal Temperament**	-2- Recorder	-8- Soft Bells
5	-2- Pitch Bend Guitar #1	-1- Pitch Bend Guitar #2	-3- Major Chord**	-4- Tuning Example*	-1- Whistle**	-4- Chorus Effect**	-3- Vibes #3	-4- Sweet Violin**,****
6	-2- Octave Glissando**	-2- Previous Timbre w/o Glissando	-4- Complex RTE Effects**	-4- Double Chiff #1	-3- Double Chiff #2	-2- Electric Piano #2	-4- Rocks	-2- Clock (Ef4)**
7	-4- Strings #1	-2- Clavinet	-1- Bass #2**	-8- Highhat #1**,****	-8- Highhat #2**,****	-4- Snare (Ef1)**,****	-1- Kick (Ef4)	-1- Anvil**
8	-2- Strings #2 ***	-3- Strings #3 ***	-3- Calimba #2 ***	-4- Soft Horn Honk***	-4- Horn Honk***	-3- Car Horn	-8- Church Bell	-8- Electric Piano #3

*Instruction timbre

**Use RTE pedal for full effect.

***Timbre used in SCRIPT examples.

****Filter switches up.

TIMBRE DISKETTE #1

	ENTRY							
	1	2	3	4	5	6	7	8
1	-1- Sine Wave	-1- Bell #1	-4- Bell #2	-8- Bell #3	-8- Multiple Bells	-1- Light Chime	-4- Multiple Chimes	-6- Repeating Chimes
2	-6- Tubular Chimes #1	-8- Tubular Chimes #2	-2- Bells	-8- Ported Bells	-2- Chimes	-3- Percussive Bass	-1- Synthesized Drums	-1- Percussive Wood
3	-1- Steel Drums	-1- Castanets	-6- Percussive Beli	-1- Short Percussion	-1- Calimba #1	-2- Calimba #2	-2- Repeating Calimba	-2- African Percussion
4	-2- Clicker**	-2- Boobam**	-1- Vibes #1	-1- Vibes #2	-1- Xylophone #1	-2- Xylophone #2	-2- Electric Dulcimer #1	-8- Electric Dulcimer #2
5	-1- Electric Piano #1	-2- Electric Piano #2	-2- Electric Piano #3	-4- Electric Piano #4	-3- Electric Piano #5	-6- Electric Piano #6	-3- Electric Piano #7	-8- Electric Piano w/ Percussion
6	-2- Electric Piano w/ Chiff	-1- Nasal Keyboard #1	-4- Nasal Keyboard #2	-8- Heavy Keyboard	-2- Harpsichord #1	-1- Harpsichord #2	-3- Plucked Harpsichord	-1- Repeating Toy Piano
7	-3- Clavinet #1	-2- Clavinet #2	-4- Low Octave Piano	-1- Organ #1	-2- Organ #2	-8- Pipe Organ #1	-8- Pipe Organ #2	-8- Pipe Organ #3
8	-1- Circus Organ	-2- Caliope**	-2- Accordion #1	-2- Accordion #2	-2- Accordion #3	-4- Accordion #4	-2- Concertina**	-8- Drone

**Use RTE pedal for full effect.

TIMBRE DISKETTE #2

	ENTRY							
	1	2	3	4	5	6	7	8
1	-1- Sine Wave	-4- Strings #1**	-8- Strings #2**	-4- Strings #3**	-4- Strings #4**	-6- Strings #5**	-8- Strings #6**	-4- Strings #7**
2	-4- Strings #8**	-4- Strings #9**	-4- Strings #10**	-4- Strings #11**	-8- Percussive Strings	-8- Strings w/portamento	-8- Multi- Stringed Percussion	-4- Slow Orchestral Bass
3	-8- Strings #12**	-4- Strings #13**	-4- Strings #14**	-4- Strings #15**	-4- Strings #16**	-4- Strings #17**	-4- Strings #18**	-4- Cello**
4	-8- Strings #19**	-4- Strings #20**	-4- Strings #21**	-4- Strings #22**	-4- Strings #23**	-4- Strings #24**	-4- Strings #25**	-8- Strings #26**
5	-4- Brass Source #1	-4- Brass Source #2	-2- Brass Source #3**	-4- Brass Source #4	-6- Brass Source #5	-6- Brass Source #6	-1- Brass Source #7	-4- Brass Source #8
6	-2- Flute #1	-6- Flute #2	-4- Oboe Source	-1- Woodwind Source	-4- Krummhorn	-2- Penny Whistle	-3- Recorder	-1- Wow
7	-8- Fuzz Guitar	-8- Fuzz Guitar w/distortion	-4- Special Effects	-4- Finger Pickin'	-1- Bass #1	-6- Bass #2	-4- Honky Tonk	-4- Disco Final Five
8	-2- Funk #1	-8- Funk #2	-1- Funk #3	-1- Funk #4	-1- Funk #6	-1- Funk #6	-4- Funk Wow	-6- Bass Funk

**Use RTE pedal for full effect.

TIMBRE DISKETTE #3 (Demo Record)
(In Order of Performance)

	ENTRY							
	1	2	3	4	5	6	7	8
1	-2- Car Horn	-8- Pipe Organ #1	-8- Pipe Organ #2	-8- Pipe Organ #3	-8- Church Bell	-8- Church Bell w/portamento	-6- B-3 Upper Manual**	-2- B-3 Lower Manual**
2	-2- B-3 Pedal	-2- Calimba	-2- Flute	-8- Orchestral Bass	-2- Cascade	-4- Shuffle Funk Guitar**	-1- Vibes	-4- Accordion
3	-1- Wood Block #1	-8- Strings w/ Portamento **	-1- Sweet Potato	-1- Xylophone	-8- Bass Tambourine	-4- Rhythm Keyboard	-2- Chimes #1	-4- Voices #1
4	-2- Brass Swell	-1- Chimes #2	-1- Chimes #3	-2- Light Sequence	-3- Strummed Guitar #1	-3- Strummed Guitar #2	-3- Strummed Guitar #3	-2- Strummed Guitar #4
5	-3- Strummed Guitar #5	-2- Strummed Guitar #6	-1- Whistle #1	-1- Whistle #2	-4- Electric Piano #1	-8- Multi Stringed Percussion	-2- Cavern	-2- Ascending Cascade
6	-4- Voices #2	-4- Solo Violin **	-2- These were substituted with the SMT button	-4- #1	-2- #2	-2- #3	-6- #4	-4- #5
7	-6- Noise Source	-1- Electric Piano #2	-1- Horn	-4- Chimes #4	-8- Plucked String	-8- Lead English Guitar	-6- Semi- Voice	-2- Sustained WOW
8	-4- Harpsichord	-8- String Section**	-2- Music Box	-6- Eastern Serenade	-2- Clavinet	-8- Harmonica	-8- Marion	-8- Giant Metal Sheet

**Use RTE pedal for full effect.

TIMBRE DISKETTE #4 (demo record in banks 1 and 2)

	ENTRY							
	1	2	3	4	5	6	7	8
1	-8- Modified Strings #1**	-8- Recorder	-3- Toms	-6- Finger Cymbals #1	-2- Castanet #1	-1- Electric Piano #3	-1- Wood	-8- Brass #1
2	-8- Primal Boesendorf	-8- Modified Strings #2**	-1- Kick Drum	-4- Snare Drum**	-1- Wood Block	-2- Keyboard Percussion	-1- Bass Guitar w/delays	-8- Finger Cymbals #2**
3	-2- Synthesizer Lead #1	-2- Synthesizer Lead #2	-1- Negative F.M. RATIO Setting	-2- Special Tuning	-2- Scale Stepper	-2- Sideband Glides	-2- Birds #1	-6- Birds #2
4	-2- Sound Effect #1	-2- Sound Effect #2	-2- Sound Effect #3	-2- Sound Effect #4	-4- Sound Effect #5	-2- Sound Effect #6**	-4- Sound Effect #7	-4- Sound Effect #8
5	-1- Sound Effect #9	-1- Sound Effect #10	-1- Sound Effect #11	-2- Music Box	-4- Weird Sound	-3- Sample & Hold Idea	-2- Water	-1- Dr. Who
6	-2- Voices	-4- Strange Voices	-1- Comedy Voice	-1- Sine	-1- Triangle	-1- Square	-1- Sawtooth	-1- Inverted Sawtooth
7	-1- Squeak	-1- A Gaggle of Squeaks	-1- Boiling	-1- Trill	-4- Octave Trill	-1- Trill in Fourths	-1- Hell to Heaven	-1- Arpeggiated Effect
8	-2- High Swell	-1- Nasal Portamento	-1- ZAP**	-2- Noise Source	-2- Chorused Sines	-4- Two Colors	-2- ????	-1- ????

**Use RTE pedal for full effect.

An error message is a special display that will appear in the digital display window when the computer cannot complete your instructions for one reason or another. Nothing is harmed or lost from computer memory when this happens. Simply correct the situation and continue.

There are ten error messages which may possibly appear during multitrack recording.

Err 1

There are 32 waveform memories for storing the harmonic coefficients of partial timbres. Although each partial timbre with a unique set of harmonic coefficients requires its own waveform memory, partial timbres with the same coefficients may share the same waveform memory, even if the partial timbres are on different tracks.

Err1 is occasionally encountered when you try to change the harmonic coefficients for the keyboard partial timbre and the waveform memories are all in use storing the waveforms of partial timbres in the memory recorder. To free up memories, erase one or more tracks from the memory recorder or recall a different keyboard timbre.

Err 2

Err2 is encountered when you try to recall a different timbre and there are not enough waveform memories available to accommodate the partial timbres in that timbre. Erase one or more tracks from the memory recorder or recall a different timbre to the keyboard.

Err 3

Err3 is encountered when you try to recall a sequence from the diskette and there are not enough waveform memories to accommodate the partial timbres in the sequence. Select a different keyboard timbre which requires fewer waveform memories and recall the sequence again.

Err 4

Each diskette has room for a certain number of sequences. Err4 is encountered when you try to access a nonexistent sequence on a diskette, for example, if you press RECORDER STORE/RECALL button 4, and the diskette you are accessing has only three sequences. Try another diskette.

Err 5

Err5 may appear when the sequence you have recalled has been created in a system with a greater amount of memory than that in your system. Err5 indicates there are more notes in the sequence than in your memory recorder.

Err 6

Err6 is encountered when you try to write a sequence onto diskette in a space that is too short for the sequence. Use a different diskette with room for a longer sequence.

Err 7

Err7 is encountered when the track you have soloed **before** pressing RECORD is not empty, but contains some notes recorded in a timbre different from the timbre active on the keyboard. You must select a different track to record on, or change the timbre on that track with the SMT button.

Err 8

Err8 is encountered when there are no free tracks when you press RECORD. You must either erase a track or change the timbre on one of the tracks to the keyboard timbre.

Err 9

Err9 is encountered during bouncing when the timbre on the originating track is not the same as the timbre on the track you are bouncing to. You will have to change one or the other.

Err 0

Err0 is encountered when you've bounced long sequences onto additional tracks without erasing and indicates that the memory recorder is out of notes. The only solution is to erase a track.

FORMATTING AND DUPLICATING DISKETTES

Eventually you will run out of storage space on your Synclavier® II diskettes. Before you can use a new blank diskette, it must be formatted and the timbre banks and sequence spaces of a Synclavier® II diskette must be copied, or duplicated, onto it.

The buttons on the Synclavier® II control panel can be used to format and duplicate diskettes, but first you must load the computer program stored on the optional SPECIAL SYNCLAVIER® II FORMAT-DUPLICATE system diskette.

LOADING FORMAT-DUPLICATE

You load this program in exactly the same way as you load the Synclavier® II operating system. You place the FORMAT-DUPLICATE system diskette in the disk drive and press the LOAD button. (In a dual drive system, place the diskette in the MAIN, or left-hand, drive.)

It will be immediately apparent that the buttons on the control panel are not going to respond in the usual way. The buttons in the two right-hand panels will blink in a continuously moving pattern as long as the FORMAT-DUPLICATE program is in computer memory.

Just press the buttons exactly as described below.

As soon as you have loaded the system, remove the FORMAT-DUPLICATE system diskette from the drive.

FORMATTING

Formatting a diskette prepares it for use. The procedure is a simple one.

1. If the new diskette is a minidiskette, you must remove the WRITE-PROTECT tab (if any) covering the small slot on the bottom edge. On the other hand, if the diskette is a maxidiskette, the tab must remain on the diskette.
2. Place the new blank diskette in the drive (in dual drive systems, place it in the left-hand drive).
3. Press these two buttons simultaneously: button 1 under PARTIAL TIMBRE SELECT and SUSTAIN under VOLUME ENVELOPE.

The START button in the center panel will start flashing.

4. Press START.

The numbers in the digital display window will begin counting while the computer formats your diskette. When it is finished, the word FinE will be displayed. The diskette is now formatted.

Unless the word FinE appears, the diskette has not been formatted and should not be used.

If, for any reason, you decide not to format the diskette, press STOP instead of START. An error message will appear in the window which simply means that you have aborted the formatting program.

DUPLICATING

To provide banks for your timbres and spaces for your sequences, you must duplicate one of the Synclavier® II system or timbre diskettes onto the formatted diskette.

To duplicate, Synclavier® II has to read the information off of one diskette — the "source" diskette — and write it onto the other diskette — the "destination" diskette. The process is somewhat different depending on whether your system has one disk drive or two.

With One Disk Drive

If you have a single disk drive system, you must insert the source diskette into the disk drive, wait for Synclavier® II to read and memorize a block of information, then take out that diskette and insert the destination diskette and wait while Synclavier® II writes the information onto it. The reading and writing may have to be repeated a number of times until the whole diskette has been read and copied.

Follow these steps carefully. The digital display window will tell you what diskette should be in the drive and the TRACKS buttons will blink to tell you which button to push.

1. Press simultaneously button 2 under PARTIAL TIMBRE SELECT and the SUSTAIN button under VOLUME ENVELOPE.

The characters "Sou", for source, should appear in the digital display window and button 1 under TRACKS should start blinking.

2. Insert the source diskette into the disk drive and press button 1 under TRACKS.

Synclavier® II will start to read the source diskette. While it reads, numbers will count in the digital display window.

When it has finished reading as much as it can, the characters "dES", for destination, will appear in the digital display window and button 9 under TRACKS will start blinking.

(If other characters appear, DO NOT CONTINUE. Refer to the special list of error displays at the end of this chapter.)

3. Take the source diskette out of the drive and insert the *formatted* destination diskette and press button 9 under TRACKS.

Synclavier® II will now write onto the diskette. When the writing process is successfully completed, the characters "FinE" or "Sou" will appear in the window. If "Sou" appears, return to Step 2. If "FinE" appears, the entire diskette has been duplicated. Return the old and new diskettes to their protective jackets.

If neither message appears, something has gone wrong and the diskette has not been copied. In this case, go to Step 1 and try again. If an error message appears, refer to the Error Displays at the end of this manual.

With Two Disk Drives

If you have a dual disk drive system, duplicating diskettes is simple.

1. Insert the *destination* diskette into the MAIN, or left-hand, disk drive.
2. Insert the *source* diskette into the AUXILIARY, or right-hand, disk drive.

Be sure to put the right diskette in the right drive!

3. Press simultaneously button 2 under PARTIAL TIMBRE SELECT and the SUSTAIN button under VOLUME ENVELOPE.

"Sou" will appear in the window and button 1 will start blinking.

4. Press button 1.

Synclavier® II should start copying the information on the source diskette onto the destination diskette.

When the operation is successfully completed, the characters "FinE" will appear in the digital display window. If there are errors, an error message will appear in the window. In this case, the diskette will not be duplicated.

5. Remove the diskettes from the drives and return them to their protective jackets.

FORMATTING AND DUPLICATING

There is a third program which combines the formatting and duplicating processes.

With One Disk Drive

1. Put your blank diskette in the drive.
2. Press DELAY and SUSTAIN under VOLUME ENVELOPE.
3. Then press START.

The computer will start formatting. When it is done, "Sou" will appear in the window and button 1 under TRACKS will start blinking.

From here on, the process is identical to the duplicating process described above.

With Two Disk Drives

1. Put your blank diskette in the left-hand drive and the source diskette in the right-hand drive.
2. Press DELAY and SUSTAIN under VOLUME ENVELOPE.

When the formatting is complete, "Sou" will appear in the digital display window and button 1 under TRACKS will start blinking.


3. Press button 1.

The information on the right-hand diskette will be copied onto the left-hand diskette.

Error Messages

The FORMAT-DUPLICATE program has its own error messages. When it detects a defective diskette or a wrong button, it will use the digital display window to tell you what has gone wrong. The following table indicates the various error messages.

- 1Err The new diskette is write-protected. Examine the diskette and remove the plastic tab if a minidiskette. Or put on tab if a maxidiskette.
- 2Err There may be a problem with the disk drive.
- 3Err The source or destination diskette may be defective.
- 4Err unused
- 5Err unused
- 6Err unused
- 7Err unused
- 8Err You have aborted the operation by pressing the STOP button.
- 9Err There is no diskette in the system disk drive.

In the section on "Designing New Waveforms," you learned to use the DIGITAL  TONE GENERATORS to adjust harmonic coefficients. To create specific complex waveforms, refer to the table below for precise settings for all the harmonics.

Harmonic #	Sawtooth	Triangle	Square	Pulse*
1	100.0	100.0	100.0	100.0
2	50.0	—	—	100.0
3	33.3	11.1	33.3	100.0
4	25.0	—	—	100.0
5	20.0	4.0	20.0	100.0
6	16.7	—	—	100.0
7	14.3	2.0	14.3	100.0
8	12.5	—	—	100.0
9	11.1	1.2	11.1	100.0
10	10.0	—	—	100.0
11	9.1	.8	9.1	100.0
12	8.3	—	—	100.0
13	7.7	.6	7.7	100.0
14	7.1	—	—	100.0
15	6.7	.4	6.7	100.0
16	6.3	—	—	100.0
17	5.9	.3	5.9	100.0
18	5.6	—	—	100.0
19	5.3	.3	5.3	100.0
20	5.0	—	—	100.0
21	4.8	.2	4.8	100.0
22	4.6	—	—	100.0
23	4.4	.2	4.4	100.0
24	4.2	—	—	100.0

*As was mentioned earlier, a more effective and easier to create PULSE is: Harmonic #1 at 0.1.